APPENDIX A

SB 151 LEGISLATION

SESSION LAW 2013-384
SENATE BILL 151

AN ACT TO AMEND MARINE FISHERIES LAWS; AMEND THE LAWS GOVERNING THE CONSTRUCTION OF TERMINAL GROINS; AND CLARIFY THAT CITIES MAY ENFORCE ORDINANCES WITHIN THE STATE'S PUBLIC TRUST AREAS.

The General Assembly of North Carolina enacts:

PART I. AMEND MARINE FISHERIES LAW

SECTION 1. G.S. 113-172 reads as rewritten:

"**§ 113-172. License agents.**

(a) The Secretary shall designate license agents for the Department. ~~At least one license agent shall be designated for each county that contains or borders on coastal fishing waters. The Secretary may designate additional license agents in any county if the Secretary determines that additional agents are needed to provide efficient service to the public.~~ The Division and license agents designated by the Secretary under this section shall issue licenses authorized under this Article in accordance with this Article and the rules of the Commission. The Secretary may require license agents to enter into a contract that provides for their duties and compensation, post a bond, and submit to reasonable inspections and audits. If a license agent violates any provision of this Article, the rules of the Commission, or the terms of the contract, the Secretary may initiate proceedings for the forfeiture of the license agent's bond and may summarily suspend, revoke, or refuse to renew a designation as a license agent and may impound or require the return of all licenses, moneys, record books, reports, license forms and other documents, ledgers, and materials pertinent or apparently pertinent to the license agency. The Secretary shall report evidence or misuse of State property, including license fees, by a license agent to the State Bureau of Investigation as provided by G.S. 114-15.1.

(b) License agents shall be compensated by adding a surcharge of one dollar ($1.00) to each license sold and retaining the surcharge. If more than one license is listed on a consolidated license form, the license agent shall be compensated as if a single license were sold. It is unlawful for a license agent to add more than the surcharge authorized by this section to the fee for each license sold."

SECTION 2.(a) G.S. 113-168.5 reads as rewritten:

"**§ 113-168.5. License endorsements for Standard Commercial Fishing License.**

(a), (b) Repealed by Session Laws 1998-225, s. 4.14.

~~(c) Menhaden Endorsements. – Except as provided in G.S. 113-169, it is unlawful to use a vessel to take menhaden by purse seine in coastal fishing waters, to land menhaden taken by purse seine, or to sell menhaden taken by purse seine without obtaining a menhaden endorsement of a SCFL. The fee for a menhaden endorsement shall be two dollars ($2.00) per ton, based on gross tonnage as determined by the custom house measurement for the mother ship. The menhaden endorsement shall be required for the mother ship but no separate endorsement shall be required for a purse boat carrying a purse seine. The application for a menhaden endorsement must state the name of the person in command of the vessel. Upon a change in command of a menhaden vessel, the owner must notify the Division in writing within 30 days.~~

(d) Shellfish Endorsement for North Carolina Residents. – The Division shall issue a shellfish endorsement of a SCFL to a North Carolina resident at no charge. The holder of a SCFL with a shellfish endorsement is authorized to take and sell shellfish."

SECTION 2.(b) G.S. 113-169 is repealed.

SECTION 2.(c) G.S. 113-168.2(a1) reads as rewritten:

"(a1) Use of Vessels. – The holder of a SCFL is authorized to use only one vessel in a commercial fishing operation at any given time. The Commission may adopt a rule to exempt from this requirement a person in command of a vessel that is auxiliary to a vessel engaged in a pound net operation, long-haul operation, or beach seine ~~operation, or menhaden~~ operation."

PART II. AMEND TERMINAL GROIN CONSTRUCTION LAW

SECTION 3.(a) G.S. 113A-115.1 reads as rewritten:

"**§ 113A-115.1. Limitations on erosion control structures.**

(a) As used in this section:

(1) "Erosion control structure" means a breakwater, bulkhead, groin, jetty, revetment, seawall, or any similar structure.

(1a) "Estuarine shoreline" means all shorelines that are not ocean shorelines that border estuarine waters as defined in G.S. 113A-113(b)(2).

(2) "Ocean shoreline" means the Atlantic Ocean, the oceanfront beaches, and frontal dunes. The term "ocean shoreline" includes an ocean inlet and lands adjacent to an ocean inlet but does not include that portion of any inlet and lands adjacent to the inlet that exhibits characteristics of estuarine shorelines.

~~(3) "Terminal groin" means a structure that is constructed on the side of an inlet at the terminus of an island generally perpendicular to the shoreline to limit or control sediment passage into the inlet channel.~~

(3) "Terminal groin" means one or more structures constructed at the terminus of an island or on the side of an inlet, with a main stem generally perpendicular to the beach shoreline, that is primarily intended to protect the terminus of the island from shoreline erosion and inlet migration. A "terminal groin" shall be pre-filled with beach quality sand and allow sand moving in the littoral zone to flow past the structure. A "terminal groin" may include other design features, such as a number of smaller supporting structures, that are consistent with sound engineering practices and as recommended by a professional engineer licensed to practice pursuant to Chapter 89C of the General Statutes. A "terminal groin" is not a jetty.

(b) No person shall construct a permanent erosion control structure in an ocean shoreline. The Commission shall not permit the construction of a temporary erosion control structure that consists of anything other than sandbags in an ocean shoreline. This ~~section~~ subsection shall not apply to any of the following:

(1) Any permanent erosion control structure that is approved pursuant to an exception set out in a rule adopted by the Commission prior to July 1, 2003.

(2) Any permanent erosion control structure that was originally constructed prior to July 1, 1974, and that has since been in continuous use to protect an inlet that is maintained for navigation.

(3) Any terminal groin permitted pursuant to this section.

(b1) This section shall not be construed to limit the authority of the Commission to adopt rules to designate or protect areas of environmental concern, to govern the use of sandbags, or to govern the use of erosion control structures in estuarine shorelines.

(c) The Commission may renew a permit for an erosion control structure issued pursuant to a variance granted by the Commission prior to July 1, 1995. The Commission may authorize the replacement of a permanent erosion control structure that was permitted by the Commission pursuant to a variance granted by the Commission prior to July 1, 1995, if the Commission finds that: (i) the structure will not be enlarged beyond the dimensions set out in the original permit; (ii) there is no practical alternative to replacing the structure that will provide the same or similar benefits; and (iii) the replacement structure will comply with all applicable laws and with all rules, other than the rule or rules with respect to which the Commission granted the variance, that are in effect at the time the structure is replaced.

(d) Any rule that prohibits permanent erosion control structures shall not apply to terminal groins permitted pursuant to this section.

(e) In addition to the requirements of Part 4 of Article 7 of Chapter 113A of the General Statutes, an applicant for a permit for the construction of a terminal groin shall submit all of the following to the Commission:

(1) Information to demonstrate that structures or infrastructure are ~~imminently threatened by erosion, and nonstructural approaches to erosion control,~~

~~including relocation of threatened structures, are impractical.~~threatened by erosion.

(2) An environmental impact statement that satisfies the requirements of G.S. 113A-4. An environmental impact statement prepared pursuant to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321, et seq., for the construction of the terminal groin shall satisfy the requirements of this subdivision.

(3) A list of property owners and local governments that may be affected by the construction of the proposed terminal groin and its accompanying beach fill project and proof that the property owners and local governments have been notified of the application for construction of the terminal groin and its accompanying beach fill project.

(4) A plan for the construction and maintenance of the terminal groin and its accompanying beach fill project prepared by a professional engineer licensed to practice pursuant to Chapter 89C of the General Statutes.

(5) A plan for the management of the inlet and the estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet. The inlet management plan monitoring and mitigation requirements must be reasonable and not impose requirements whose costs outweigh the benefits. The inlet management plan is not required to address sea level rise. The inlet management plan shall do all of the following relative to the terminal groin and its accompanying beach fill project:

a. Describe the post-construction activities that the applicant will undertake to monitor the impacts on coastal resources.

b. Define the baseline for assessing any adverse impacts and the thresholds for when the adverse impacts must be mitigated.

c. Provide for mitigation measures to be implemented if adverse impacts reach the thresholds defined in the plan.

d. Provide for modification or removal of the terminal groin if the adverse impacts cannot be mitigated.

(6) Proof of financial assurance verified by the Commission or the Secretary of Environment and Natural Resources in the form of a bond, insurance policy, escrow account, guaranty, local government taxing or assessment authority, a property owner association's approved assessment, or other financial instrument or combination of financial instruments that is adequate to cover the cost ~~of:~~of implementing all of the following components of the inlet management plan:

a. Long-term maintenance and monitoring of the terminal groin.

b. Implementation of mitigation ~~measures as provided in the inlet management plan.~~measures.

c. Modification or removal of the terminal ~~groin as provided in the inlet management plan.~~groin.

~~d.~~ ~~Restoration of public, private, or public trust property if the groin has an adverse impact on the environment or property.~~

(f) The Commission shall issue a permit for the construction of a terminal groin if the Commission finds no grounds for denying the permit under G.S. 113A-120 and the Commission finds all of the following:

(1) The applicant has complied with all of the requirements of subsection (e) of this section.

~~(2)~~ ~~The applicant has demonstrated that structures or infrastructure are imminently threatened by erosion and that nonstructural approaches to erosion control, including relocation of threatened structures, are impractical.~~

(3) The terminal groin will be accompanied by a concurrent beach fill project to prefill the groin.

(4) Construction and maintenance of the terminal groin will not result in significant adverse impacts to private property or to the public recreational beach. In making this finding, the Commission shall take into account the potential benefits of the project, including protection of the terminus of the

island from shoreline erosion and inlet migration, beaches, protective dunes, wildlife habitats, roads, homes, and infrastructure, and mitigation measures, including the accompanying beach fill project, that will be incorporated into the project design and construction and the inlet management plan.

(5) The inlet management plan is adequate for purposes of monitoring the impacts of the proposed terminal groin and mitigating any adverse impacts identified as a result of the monitoring.

(6) Except to the extent expressly modified by this section, the project complies with State guidelines for coastal development adopted by the Commission pursuant to G.S. 113A-107.

(g) The Commission may issue no more than four permits for the construction of a terminal groin pursuant to this section.

(h) ~~No permit may be issued where funds are~~A local government may not use funds generated from any of the following financing mechanisms ~~and would be used~~ for any activity related to the terminal groin or its accompanying beach fill project:

(1) Special obligation bonds issued pursuant to Chapter 159I of the General Statutes.

(2) Nonvoted general obligation bonds issued pursuant to G.S. 159-48(b)(4).

(3) Financing contracts entered into under G.S. 160A-20 or G.S. 159-148.

(i) No later than September 1 of each year, the Coastal Resources Commission shall report to the Environmental Review Commission on the implementation of this section. The report shall provide a detailed description of each proposed and permitted terminal groin and its accompanying beach fill project, including the information required to be submitted pursuant to subsection (e) of this section. For each permitted terminal groin and its accompanying beach fill project, the report shall also provide all of the following:

(1) The findings of the Commission required pursuant to subsection (f) of this section.

(2) The status of construction and maintenance of the terminal groin and its accompanying beach fill project, including the status of the implementation of the plan for construction and maintenance and the inlet management plan.

(3) A description and assessment of the benefits of the terminal groin and its accompanying beach fill project, if any.

(4) A description and assessment of the adverse impacts of the terminal groin and its accompanying beach fill project, if any, including a description and assessment of any mitigation measures implemented to address adverse impacts."

SECTION 3.(b) Section 3 of S.L. 2011-387 is repealed.

PART III. CITIES ENFORCE ORDINANCES WITHIN PUBLIC TRUST AREAS

SECTION 4.(a) Article 8 of Chapter 160A of the General Statutes is amended by adding a new section to read as follows:

"**§ 160A-203. Cities enforce ordinances within public trust areas.**

(a) Notwithstanding the provisions of G.S. 113-131 or any other provision of law, a city may, by ordinance, define, prohibit, regulate, or abate acts, omissions, or conditions upon the State's ocean beaches and prevent or abate any unreasonable restriction of the public's rights to use the State's ocean beaches. In addition, a city may, in the interest of promoting the health, safety, and welfare of the public, regulate, restrict, or prohibit the placement, maintenance, location, or use of equipment, personal property, or debris upon the State's ocean beaches. A city may enforce any ordinance adopted pursuant to this section or any other provision of law upon the State's ocean beaches located within or adjacent to the city's jurisdictional boundaries to the same extent that a city may enforce ordinances within the city's jurisdictional boundaries. A city may enforce an ordinance adopted pursuant to this section by any remedy provided for in G.S. 160A-175. For purposes of this section, the term "ocean beaches" has the same meaning as in G.S. 77-20(e).

(b) Nothing in this section shall be construed to (i) limit the authority of the State or any State agency to regulate the State's ocean beaches as authorized by G.S. 113-131, or common law as interpreted and applied by the courts of this State; (ii) limit any other authority granted to cities by the State to regulate the State's ocean beaches; (iii) deny the existence of the authority recognized in this section prior to the date this section becomes effective; (iv) impair the right of the people of this State to the customary free use and enjoyment of the State's ocean beaches, which rights remain reserved to the people of this State as provided in G.S. 77-20(d); (v) change or modify the riparian, littoral, or other ownership rights of owners of property bounded by the Atlantic Ocean; or (vi) apply to the removal of permanent residential or commercial structures and appurtenances thereto from the State's ocean beaches."

SECTION 4.(b) G.S. 113-131 reads as rewritten:

"**§ 113-131. Resources belong to public; stewardship of conservation agencies; grant and delegation of powers; injunctive relief.**

(a) The marine and estuarine and wildlife resources of the State belong to the people of the State as a whole. The Department and the Wildlife Resources Commission are charged with stewardship of these resources.

(b) The following powers are hereby granted to the Department and the Wildlife Resources Commission and may be delegated to the Fisheries Director and the Executive Director:

(1) Comment on and object to permit applications submitted to State agencies which may affect the public trust resources in the land and water areas subject to their respective management duties so as to conserve and protect the public trust rights in such land and water areas;

(2) Investigate alleged encroachments upon, usurpations of, or other actions in violation of the public trust rights of the people of the State; and

(3) Initiate contested case proceedings under Chapter 150B for review of permit decisions by State agencies which will adversely affect the public trust rights of the people of the State or initiate civil actions to remove or restrain any unlawful or unauthorized encroachment upon, usurpation of, or any other violation of the public trust rights of the people of the State or legal rights of access to such public trust areas.

(c) Whenever there exists reasonable cause to believe that any person or other legal entity has unlawfully encroached upon, usurped, or otherwise violated the public trust rights of the people of the State or legal rights of access to such public trust areas, a civil action may be instituted by the responsible agency for injunctive relief to restrain the violation and for a mandatory preliminary injunction to restore the resources to an undisturbed condition. The action shall be brought in the superior court of the county in which the violation occurred. The institution of an action for injunctive relief under this section shall not relieve any party to such proceeding from any civil or criminal penalty otherwise prescribed for the violation.

(d) The Attorney General shall act as the attorney for the agencies and shall initiate actions in the name of and at the request of the Department or the Wildlife Resources Commission.

(e) In this section, the term "public trust resources" means land and water areas, both public and private, subject to public trust rights as that term is defined in G.S. 1-45.1.

(f) Notwithstanding the provisions of this section, a city may adopt and enforce ordinances as provided in G.S. 160A-203."

PART IV. EFFECTIVE DATE

SECTION 5. Section 3 of this act is effective when the act becomes law and applies to permit applications submitted on or after that date. The remainder of this act is effective when it becomes law.

In the General Assembly read three times and ratified this the 22nd day of July, 2013.

s/ Tom Apodaca
Presiding Officer of the Senate

s/ Thom Tillis
Speaker of the House of Representatives

s/ Pat McCrory
Governor

Approved 10:45 a.m. this 23rd day of August, 2013

APPENDIX B

INLET MANAGEMENT PLAN

(Prepared by the Village of Bald Head Island, Applicant)

VILLAGE OF BALD HEAD ISLAND, NC
TERMINAL GROIN PROJECT

INLET MANAGEMENT PLAN

I. SETTING

In order to comply with the requirements of SB110, an applicant for a permit to construct a terminal groin must formulate a plan for the management of the inlet, estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet.

The requisite inlet management plan shall do all of the following relative to the terminal groin and its accompanying beach fill project:

1. Describe the post-construction activities that the applicant will undertake to monitor the impacts on coastal resources.
2. Define the baseline for assessing any adverse impacts and the thresholds for when the adverse impacts must be mitigated.
3. Provide for mitigation measures to be implemented if adverse impacts reach the thresholds defined in the plan.
4. Provide for modification or removal of the terminal groin if the adverse impacts cannot be mitigated.

Inlet management plan formulation is different for an inlet improved for navigation versus one which is in a relatively unimproved condition. Also influencing various potential management precepts is the size of the inlet, its history and any associated disposal operation which presently benefits one, or both, of the abutting coastal barrier shorelines. Such is the case with the entrance to the Cape Fear River where a proactive Sand Management Plan has been in effect for over a decade. The subject Wilmington Harbor Sand Management Plan (WHSMP) is implemented by the Wilmington District, United States Army Corps of Engineers ("USACOE") during routine maintenance of the innermost three (3) segments of the Ocean Entrance Channel which comprise a portion of the Wilmington Harbor Navigation Project.

Up until 1999, the Wilmington Harbor navigation project had historically not included the disposal of littoral sand on the adjacent beaches, or in the active littoral zone. This had been primarily due to the maintenance practices that were established with the inception of the project in the late 1800's. As a result, standard practice for maintaining the ocean entrance channel segments of the project was offshore disposal in water depths of 30 ft or more.

With the last harbor deepening project and coincident reorientation of the ocean entrance channel, the Wilmington District established a new standard for the disposal of littoral sediment. From an engineering perspective, a purpose of the Wilmington Harbor maintenance program was to avoid or mitigate potential erosion of the adjacent beaches by conserving the limited natural resource, sand, through deposition directly on the adjacent coastal barrier beaches.

Pursuant to the adopted Plan, the initial ratio of distribution of littoral sand excavated during routine maintenance operations between Bald Head Island and East Oak Island – Caswell Beach was proposed by the District in the ratio of two-thirds to one-third, respectively. The WHSMP was initiated as part of the first maintenance project following initial improvements of the deepening project. Beach quality sand originating from project widening, deepening and channel reconfiguration was likewise distributed between the two islands with sand being placed westward on Oak Island as far as Holden Beach.

The Cape Fear River Entrance is a historically federally improved tidal inlet which includes a deep draft commercial navigation project channel authorized by Congress intended to serve the Port of Wilmington Harbor, N.C. None-the-less, both the interior flood shoals, the exterior ebb shoals as well as portions of the navigation channel which are subject to shoaling with beach quality sand, all serve as potential sand sources necessary to meet the performance requirements of SB110 regarding terminal groin mitigation – as well as supplemental beach fill necessary to prefill a terminal groin. Moreover, the regularly scheduled disposal of large quantities of high quality sand (typically 1 Mcy, or more) associated with the WHSMP offers opportunities for the applicant for a terminal groin permit to strategically schedule groin construction in such a manner so as to utilize beach disposal sand to meet the beach fill requirement of the enabling terminal groin legislation.

II. PHYSICAL MONITORING PLAN

A. Background

The Village of Bald Head Island, NC (Village) has performed comprehensive beach monitoring of South Beach, The Point and West Beach since 1999. Prior to that date, less formal surveys of the "dry" beach (only) were also accomplished at varying dates in time. In 2008, East

Beach was added to the current monitoring plan. Elements of the present day survey program under the WHSMP include the nearshore portions of Bald Head Shoal and the abutting federal navigation project. Borrow sites are likewise monitored for a minimum period of 3 years after any Village sponsored excavation required for shore protection.

A detailed report of findings is issued annually by the coastal engineering firm Olsen Associates, Inc., on behalf of the Village, which generally addresses:

1. Recent volume and shoreline position changes measured over the prior twelve (12) months.
2. Comparisons of existing and long-term conditions relative to pre-fill conditions documented since November 2000 by annual surveys.
3. Monitoring of the sand tube groinfield last reconstructed in 2010 and repaired in 2013.
4. Discussions of the performance of each last major sand placement project, (federal as well as non-federal).
5. Recent navigation channel changes including those at/or abutting "The Point" – an area of chronic shoaling and highly dynamic shoreline change.

B. Plan Purpose

The monitoring plan discussed herein is intended to meet the requirements of State and Federal law addressing a.) beach restoration activities on Bald Head Island including borrow site creation, b.) reconstruction and maintenance of a sixteen (16) structure sand tube groinfield, as well as c.) permits for a terminal groin structure proposed for construction at the western end of South Beach – along with any attendant borrow site excavation (if necessary) and sand fill.

Specific elements of new work associated with the monitoring of the terminal groin will be directed toward the identification of and quantification of any detrimental project related downdrift changes to the Point and/or West Beach which could potentially warrant mitigation. Interpretation of post-construction surveys will be influenced by historical data detailing ongoing erosional trends at these two locations. For example, documented beach erosion at West Beach over the last decade (in the absence of the terminal structure) has necessitated several protection sand fills with the most recent occurring in early 2013. The latter occurred as part of a federal maintenance dredging operation with sand disposal totaling 1.8 Mcy placed at Bald Head Island. Hence, an important component of the expanded monitoring program will be to not only evaluate structure performance, but also to discern any differences in downdrift erosion that could be associated with the construction of a terminal groin.

Additionally, the Applicant for a terminal groin is charged with preparing a plan for the management of the inlet and the estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet. The Division of Coastal Management has taken the position that, despite the presence of the three (3) mile distance and maintained navigation channel, some monitoring is required at the easternmost end of Oak Island at Caswell Beach.

C. Beach Surveys

i. Bald Head Island

For purposes of documenting both future beach disposal and terminal groin project performance and shoreline change, The Village will continue to perform comprehensive annual beach monitoring as carried out over the past thirteen (13) years at Bald Head Island. The survey baseline for this work is depicted by **Figure 1**. Profiles are surveyed twice annually (seasonally) on approximately 400-ft. intervals. Profiles generally extend some 2400-ft. or more offshore and include the depth of closure for natural beach conditions – except where intersected by the federal navigation channel, or a major shoal feature. All surveys are performed by a certified hydrographic surveyor registered in the State of North Carolina.

Several additional profile lines will be added to the existing survey program in the vicinity of the terminal structure (see **Figure 2**). In addition, the project surveyor will be required to annually perform an approximate MHWL survey between Sta. 0+00 and 75+00 (see **Figure 3**). Each survey will be compared to prior surveys and utilized for trend analysis. Digitally controlled aerial photography taken at approximate 6-month intervals will likewise be used to supplement analysis of the post-terminal groin shoreline condition.

The first post-construction MHWL survey will be performed within 30 days of the completion of the proposed terminal groin and beach fill, thereby documenting the as-built shoreline condition. The entire island-wide monitoring surveys will be performed on a six-month basis at the same approximate time as previous seasonal survey program addressed by the existing (pre-groin) comprehensive island-wide beach monitoring program.

ii. Oak Island

For approximately the past 12 years, the Wilmington District has performed comprehensive physical monitoring which included both the Oak Island and Bald Head Island shorelines. The purpose of this program has been to examine the response of adjacent beaches, entrance channel shoaling patterns and the ebb tidal delta to the Wilmington Harbor channel deepening and realignment project. As a result, a comprehensive data base has been developed which portrays shoreline changes at both locations for over a decade. For purposes of assessing post-construction shoreline conditions on the eastern end of Oak Island, the Village's coastal engineering consultant will utilize survey data acquired by the Wilmington District, USACOE. Similarly, the consultant shall access and utilize relevant federal aerial photography of the Oak Island area of interest.

Should the federal physical monitoring program be terminated for fiscal or other reasons, the Village will perform limited beach monitoring (one survey per year) at 12 survey stations located at baseline stations mutually acceptable to both the Village and Caswell Beach. The Village will likewise provide aerial photography coverage of the survey area at or close to the time of the Caswell Beach survey. The Village's responsibility for post-groin physical surveying on Oak Island will terminate if three (3) years of monitoring subsequent to terminal groin structure completion fails to indicate any level of cause or effect relationship between structure installation and shoreline change at Oak Island.

D. Borrow Site Monitory Surveys

The existing permitted borrow area located on Jay Bird Shoals was surveyed both immediately prior to and after construction of the 09/10 Village sponsored 1.8 Mcy beach restoration project (see **Figure 4**). Subsequent surveys are being performed at 12-, 24- and 36-months and biennially thereafter. The area surveyed includes a minimum of 500-ft. of coverage outside the permit limits of the borrow site. The survey is performed by single beam sonar on a density line spacing of 100-ft. Due to emergent portions of Joiner Shoal at the north, up to 72-acres of shallow seabed may need to be surveyed by non-sonar methods. In this area the surveyor may use single beam sonar on a shallow draft boat, or wading profiles at low tide using RTKGPS. A 100-ft. grid spacing will continue to be maintained at this location, irrespective of methodology required. Subsequent to a Post-Irene emergency dredging project at South and

West Beach constructed in 2011/12, a Bald Head Creek borrow site is subject to annual surveys beginning in January 2013 (see **Figure 4**). The project fill volume was 120,000 cy.

Borrow sites utilized for locally funded sand placement operations at Bald Head Island shall be monitored in accordance with the Permit Condition associated with each project. Should locally funded sand placement required by the construction of the terminal groin necessitate the borrowing of sand from within the remaining (1 Mcy) unexcavated (permitted) portion of the Jay Bird Shoal borrow site; the entrance to Bald Head Creek; the Smith Island Range of the federal navigation channel, or any other permitted site, annual monitoring of that site shall be performed – pursuant to the terms of the associated permit. Monitoring results shall be addressed in each subsequent annual monitoring report.

E. Hydrographic Survey Standards

In general, the following will apply to *all* surveys:

- Surveys will be performed to meet or exceed the Minimum Performance Standards for the USACOE Hydrographic Surveys. Specifications manual EM 1110-2-1003, January 2002 (or its successor).
- All data will be corrected for tide and heave.
- The survey vessel will be positioned using RTKGPS. Soundings will be in feet and 10^{th}'s.
- Vertical Datum will be local NGVD29.
- Horizontal Datum will be NC NAD83.

F. Aerial Photography

The Village of Bald Head Island will continue to perform controlled (color) rectified digital aerial photography of the island shoreline(s) twice a year – usually coincident with the timing of each seasonal beach survey. The present minimum areas of coverage are the West Beach, South Beach and East Beach shorelines. Oblique low altitude photography is likewise performed periodically as required to document the occurrences of any storm, or man-made event of interest. Any repair of the sand tube groinfield is likewise documented by ground level digital photography.

As noted above, aerial coverage of the easternmost 3 miles of Oak Island shoreline shall be performed (coincident with each beach survey) – should ongoing federal physical monitoring cease at that location.

G. Reporting

A comprehensive report-of-findings will continue to be issued annually which presents, analyses and discusses all data acquired over the prior twelve (12) month period. Of particular interest will be beach and borrow site changes which occur over time and any potential effects downdrift of the proposed terminal structure. Each report will likewise discuss, consider and compare the relevant portions of the historical database as it relates to the most current survey(s).

All patterns of erosion, accretion or shoaling will be documented, quantified and graphically depicted. For any project borrow site, map differencing will be performed annually (and cumulatively over time) for purposes of visually demonstrating spatially occurring changes in elevations due to shoaling. For the Point and West Beach downdrift shorelines, comparative MHWL and aerial mapping will be presented subsequent to terminal groin construction along with volumetric analyses currently being computed every 6 months.

The consultant will maintain and expand the present day comprehensive monitoring report format and deliverables to include specific Sections which specifically address borrow site construction and all subsequent changes over time, as well as terminal groin and sand fillet performance and downdrift (post-structure) shoreline history, in addition to shoreline changes occurring at Caswell Beach.

H. Deliverables

Annual monitoring reports will be delivered to the Village of Bald Head Island, Caswell Beach and all relevant State or Federal regulatory agencies within 90-days of completion of the last survey performed for the reporting period of interest. Additionally, digital data acquired or addressed by each Annual Report can be transferred to an Agency or Stakeholder, upon request.

III. MITIGATION THRESHOLDS

A. Baselines for Evaluation

Both the West Beach updrift shorelines and the cross-inlet Oak Island – Caswell Beach shorelines have over 12 years worth of post-deepening (1999-present) survey data to document shorefront conditions. Most data take the form of cross-share profiling at intervals sufficient to document volumetric change and contour location along the shorefront of interest. Supplementary aerial photography is likewise available to assist with the interpretation of survey data.

The more recent (decadal) data will be the most relevant due to changes in navigation project dimensions, corresponding episodic dredging operations within the entrance channel and, most importantly, the equilibration of beach disposal projects which seeks to improve shoreline conditions. Interpretation of the latter phenomena will be extremely important since the temporal variation in shoreline change (volume and location) – after a beach fill – is typically significant. Both Oak Island and Bald Head Island have received, and will continue to receive, large scale beach disposal projects (typically exceeding 1 Mcy per event) in accordance with the Wilmington Harbor Sand Management Plan.

B. Impact Determination – West Beach

Both West Beach and the depositional spit feature known as the Point lie downdrift of the terminal structure proposed at the westernmost limit of South Beach. As a result, both are subject to change as the downdrift shorefront seeks a post-structure equilibrium condition. Currently, it is expected that a portion of the West Beach shorefront will require beach disposal on a 3-year basis – with or without structure implementation. The assignment of impact on West Beach to a terminal structure will therefore need to weigh the following site specific downdrift conditions:

- Interval between sand placement projects?
- Have shoreline recession rates (volumes and MHWL) increased by over 50%? Has beach fill equilibration been accounted for?
- Can a documented cause and effect relationship be assigned to downdrift shoreline reconfiguration, or is any newly developed "hot spot" isolated and therefore not the result of a quantifiable trend?
- Do numerical modeling results support or refute the observed shoreline erosion trends?
- Can extraordinary meteorological conditions be defined as a cause of accelerated erosion?
- Have navigation channel maintenance operations changed in frequency or scope?

C. Impact Determination – Oak Island (Caswell Beach)

Although neither numerical modeling analyses nor historical monitoring data support the possibility of terminal groin project related impacts to the eastern end of Oak Island, relevant determination criteria are none-the-less required. The most recent, published USACOE survey monitoring data for Oak Island (through 2010) indicates a near term general trend of fill stability with very modest average annual sediment losses. One exception is at baseline monitoring stations 35 and 40 where a localized "hot spot" has been in existence over the last decade. Recent back beach or dune erosion at this location has been of recent concern to interests associated with Fort Caswell.

The assignment of impact to the easternmost segments of Oak Island (*i.e*. Caswell Beach) will need to weigh the following conditions:

- Are changes in shoreline conditions isolated, or are they the result of a clear reversal in trend?
- Has recent beach disposal occurred? Is fill equilibration affecting rates of shoreline translation?
- Can extraordinary meteorological conditions be defined as a cause of accelerated erosion?
- Has the pre-existing erosional hot spot identified on the eastern Oak Island shorefront increased in magnitude (i.e. either volumetrically or spatially)?
- Does numerical modeling of terminal groin project related borrow site construction activities (for purposes of obtaining beach fill) refute or support a cause and effect relationship?
- Have navigational channel maintenance operations changed in frequency or scope?

IV. MITIGATION

A. West Beach

The highest priority for any required mitigation on West Beach would be alongshore sand placement sufficient to protect endangered residential structures. It is probable however that the timing of an expeditious (and sizeable) sand placement project may be adversely affected by other factors such as permitting, dredge availability, and public project bid requirements. As a result, interim actions may be considered: (1) sand bag revetment construction along the section of shorefront where threatened structures exist, (2) temporary borrowing of sand mechanically from the updrift impoundment fillet of the terminal groin – with placement along the chronically eroded shorefront, or (3) both actions.

Coincident with any level of remedial action should be consideration of structure modification. In most instances, such an action would consist of rock removal from the structure crest sufficient to increase its transmissivity to sand transport. That is to say, its permeability (or "leakiness") would be increased. Such an action would not be expected to result in immediate benefits. Hence, it should be considered to be a secondary response in the hierarchy of remedial actions.

B. Oak Island

Although difficult, if not impossible, to verify, any recorded increase in erosion on the Caswell Beach section of Oak Island that is attributed to the proposed Bald Head Island terminal groin would need to be mitigated through direct sand placement. The most logical source of beach quality sand is the WHSMP. Accordingly, mitigation would occur through a reapportionment of some portion of the federal disposal sand to that hot spot, rather than placement of the sand at a more stable or accreting location. The Village may consider, in consultation with the Town of Caswell Beach, other measures to address the erosion, such as a sand push, sandbag revetment or relocation of sand via truck..

V. TERMINAL STRUCTURE ALTERATION

As discussed previously, the proposed terminal groin is to be constructed as a "leaky" structure with some level of reduced sediment transport continuing to occur either through and/or over the structure crest. As a rubble mound structure, sand permeability can be physically increased through the removal of stones. Any reduction in effective structural elevation will increase sediment transport across the groin. Increased transport would be conducive to spit or dry beach growth on the downdrift side of the structure which, in effect, would be expected to increase sediment transport to West Beach. Such "tuning" of a permeable structure is often desirable even if mitigation is not required. Normally, tuning would not occur without the benefit of significant post-construction monitoring, since the transmissivity of such a structure varies over time – dependent upon the condition (*i.e.* size and elevation) of the updrift sand fillet.

In the limit, the elimination of such a structure is possible so as to return the subject shoreline to pre-project hydrodynamic and littoral transport conditions. Pragmatically, lowering of the structure to grade through armor rock removal would constitute "effective" structure elimination.

APPENDIX C

SCOPING DOCUMENTS

AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

ACTION: Notice to Delete a System of Records.

SUMMARY: The Defense Intelligence Agency is deleting a system of records notice in its existing inventory of record systems subject to the Privacy Act of 1974 (5 U.S.C. 552a), as amended.

DATES: This proposed action will be effective on April 13, 2012 unless comments are received which result in a contrary determination.

ADDRESSES: You may submit comments, identified by docket number and title, by any of the following methods:

* *Federal Rulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.

* *Mail:* Federal Docket Management System Office, 4800 Mark Center Drive, East Tower, 2nd Floor, Suite 02G09, Alexandria, VA 22350–3100.

Instructions: All submissions received must include the agency name and docket number for this **Federal Register** document. The general policy for comments and other submissions from members of the public is to make these submissions available for public viewing on the Internet at *http://www.regulations.gov* as they are received without change, including any personal identifiers or contact information.

FOR FURTHER INFORMATION CONTACT: Ms. Theresa Lowery at (202) 231–1193.

SUPPLEMENTARY INFORMATION: The Defense Intelligence Agency systems of records notices subject to the Privacy Act of 1974 (5 U.S.C. 552a), as amended, have been published in the **Federal Register** and are available from the individual listed in **FOR FURTHER INFORMATION CONTACT**. The proposed deletion is not within the purview of subsection (r) of the Privacy Act of 1974 (5 U.S.C. 552a), as amended, which requires the submission of a new or altered system report.

Dated: March 8, 2012.

Aaron Siegel,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

DELETION:

LDIA 06–0002

SYSTEM NAME:

Department of Defense Intelligence Information Systems Access, Authorization, and Control Records (April 11, 2007, 72 FR 18209).

REASON:

Records have been incorporated into LDIA 07–0003, entitled Department of Defense Intelligence Information System (DoDIIS) Customer Relationship Management System. The records will assume the same retention schedule as listed in LDIA 07–0003.

[FR Doc. 2012–6003 Filed 3–13–12; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent To Prepare a Draft Environmental Impact Statement (DEIS) for the Installation of a Terminal Groin Structure at the Western End of South Beach, Bald Head Island, in Close Proximity to the Federal Wilmington Harbor Channel of the Cape Fear River (Brunswick County, NC)

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Corps of Engineers (USACE), Wilmington District, Wilmington Regulatory Field Office has received a request for Department of the Army authorization, pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbor Act, from the Village of Bald Head Island (VBHI) to develop and implement a shoreline protection plan that includes the installation of a terminal groin structure on the east side of the Wilmington Harbor Baldhead Shoal Entrance Channel (a federally-maintained navigation channel of the Cape Fear River) at the "Point" of Bald Head Island. The structure will be designed to be strategically incorporated into the federal beach disposal operations associated with the Wilmington Harbor Sand Management Plan.

DATES: A public scoping meeting for the DEIS will be held at the ILA Hall, located at 211 West 10th Street in Southport (NC) on March 22, 2012 at 6 p.m. Written comments will be received until April 9, 2012.

ADDRESSES: Copies of comments and questions regarding scoping of the DEIS may be submitted to: U.S. Army Corps of Engineers, Wilmington District, Regulatory Division. ATTN: File Number SAW–2012–00040, 69 Darlington Avenue, Wilmington, NC 28403.

FOR FURTHER INFORMATION CONTACT: Questions about the proposed action and DEIS can be directed to Mr. David Timpy, Project Manager, Wilmington Regulatory Field Office, telephone: (910) 251–4634. Additional description of the VBHI's proposal can be found at the following link, *http://www.saw.usace.army.mil/WETLANDS/Projects/index.html,* under the Village of Bald Head Island Terminal Groin Project.

SUPPLEMENTARY INFORMATION:

1. Project Description

The west end of South Beach has experienced both chronic mid-term (decadal) and accelerated short-term erosion losses (with direct impacts to beaches and dunes of this segment of shoreline). A nourishment project has been employed by the VBHI to mitigate the effects of these losses. In addition, several million cubic yards of sand from a Federal navigation project has been disposed on the beach since 1991. Despite this sand placement on the beach, a portion of South Beach continues to experience substantial erosion, potentially impacting public infrastructure and homes. It is the VBHI's desire to implement a long-term beach and dune stabilization strategy. The applicant contends that a necessary component to the success of this strategy is the installation of a terminal groin that would (1) reduce inlet-directed sand losses from beach fill construction projects; and (2) stabilize shoreline alignment along the westernmost segment of South Beach in such a manner that alongshore transport rates are reduced. The VBHI proposal calls for the construction of a single terminal groin designed to compliment future placement of beach fill at South Beach. The structure will serve as a "template" for fill material placed eastward of the proposed terminal groin. In that regard, the groin will be designed as a "leaky" structure (i.e. semi-permeable) so as to provide for some level of sand transport to West Beach (located northward of the proposed groin).

2. Issues

There are several potential environmental and public interest issues that will be addressed in the DEIS. Additional issues may be identified during the scoping process. Issues initially identified as potentially significant include:

a. Potential impacts to marine biological resources (benthic organisms, passageway for fish and other marine life) and Essential Fish Habitat.

b. Potential impacts to threatened and endangered marine mammals, birds, fish, and plants.

c. Potential impacts to adjacent shoreline changes on West Beach of Bald Head Island and adjacent shorelines.

d. Potential impacts to Navigation, commercial and recreational.

e. Potential impacts to the long-term management of the oceanfront shorelines.

f. Potential effects on regional sand sources and how it relates to sand management practices and North Carolina's Beach Inlet Management Practices.

g. Potential effects of shoreline protection.

h. Potential impacts on public health and safety.

i. Potential impacts to recreational and commercial fishing.

j. Potential impacts to cultural resources.

k. Cumulative impacts of past, present, and foreseeable future dredging and nourishment activities.

3. Alternatives

Several alternatives are being considered for the development of the protection plan. These alternatives will be further formulated and developed during the scoping process and an appropriate range of alternatives, including the no federal action alternative, will be considered in the DEIS.

4. Scoping Process

A public scoping meeting (see **DATES**) will be held to receive public comment and assess public concerns regarding the appropriate scope and preparation of the DEIS. Participation in the public meeting by federal, state, and local agencies and other interested organizations and persons is encouraged.

The USACE will consult with the U.S. Fish and Wildlife Service under the Endangered Species Act and the Fish and Wildlife Coordination Act; with the National Marine Fisheries Service under the Magnuson-Stevens Fishery Conservation and Management Act and the Endangered Species Act; and with the North Carolina State Historic Preservation Office under the National Historic Preservation Act. Additionally, the USACE will coordinate the DEIS with the North Carolina Division of Water Quality (NCDWQ) to assess the potential water quality impacts pursuant to Section 401 of the Clean Water Act, and with the North Carolina Division of Coastal Management (NCDCM) to determine the projects consistency with the Coastal Zone Management Act. The USACE will closely work with NCDCM and NCDWQ in the development of the DEIS to ensure the process complies with current State Environmental Policy Act (SEPA) requirements. It is the intention of both the USACE and the State of North Carolina to consolidate the NEPA and SEPA processes thereby eliminating duplication.

6. Availability of the DEIS

The DEIS is expected to be published and circulated by the end of 2012. A public hearing will be held after the publication of the DEIS.

Dated: March 2, 2012.

Scott McLendon,

Assistant Chief, Regulatory Division.

[FR Doc. 2012–6127 Filed 3–13–12; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Public Scoping Meeting and Preparation of Environmental Impact Statement for Baryonyx Corporation, Inc.'s Proposed Wind Farm, Offshore, Willacy and Cameron Counties, TX

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of Intent.

SUMMARY: The U.S. Army Corps of Engineers, Galveston District, has received a permit application for a Department of the Army (DA) Permit pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344) from Baryonyx Corporation, Inc. (SWG–2011–00511) for the proposed approximately 300-turbine offshore wind farm located in the Gulf of Mexico state waters, offshore Willacy and Cameron Counties in state tracts: 1068, 1069, 1085, 1086, 1087, 1088, 1089, 1090, 1126, 1127, 1129, 1130 and 1131. The primary Federal involvement associated with the proposed action is the discharge or dredged or fill material into waters of the United States, and the construction of structures that may affect navigable waters. Federal authorizations for the proposed project would constitute a "major federal action." Based on the potential impacts, both individually and cumulatively, the Corps intends to prepare an Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act to render a final decision on the permit applications.

The Corps' decision will be to issue, issue with modification or deny DA permits for the proposed action. The EIS will assess the potential social, economic and environmental impacts of the construction and operation of the offshore wind farm, associated facilities, and appurtenances and is intended to be sufficient in scope to address Federal, State and local requirements, environmental and socio-economic issues concerning the proposed action, and permit reviews.

DATES: The agency must receive comments on or before May 14, 2012.

ADDRESSES: You may submit comments by any of the following methods: *Mail:* Jayson M. Hudson, U.S. Army Corps of Engineers, Regulatory Branch, P.O. Box 1229, Galveston, TX 77553–1229; *Fax:* (409) 766–3931 or *Email: SWG201151 1@usace.army.mil.* Emailed comments, including attachments, should be provided in .doc, .docx, .pdf or .txt formats. Documents pertinent to the proposed project may be examined at *http://www.swg.usace.army.mil/reg/eis.asp.*

FOR FURTHER INFORMATION CONTACT: Mr. Jayson Hudson, (409) 766–3108.

SUPPLEMENTARY INFORMATION: The Galveston District intends to prepare an EIS on the proposed Baryonyx offshore wind farm which would include the proposed construction of approximately 300 offshore turbines in the Gulf of Mexico offshore Willacy and Cameron Counties, TX. Baryonyx Corporation, Inc. proposed this project and is the applicant for the DA permit SWG–2011–00511.

1. *Project Background:* The applicant proposes to construct an approximately 300-turbine wind farm in two areas referred to as the North Rio Grande Lease and Rio Grande Lease. The project is located in Gulf of Mexico state waters, offshore Willacy and Cameron Counties in state tracts: 1068, 1069, 1085, 1086, 1087, 1088, 1089, 1090, 1126, 1127, 1129, 1130 and 1131. The proposed project consists of the following:

a. *Wind Turbines and Foundations:* Each lease site will be comprised of 100–200 wind turbine generators in a grid pattern (turbine array). The final locations will be determined by consultation with appropriate state and federal agencies and consideration of constraints including: wind resource characteristics; safety and navigation; technical characteristics of the wind turbine generators; electrical collection system characteristics; geophysical site constraints; and environmental and ecological considerations. The specific turbine has not been selected so that Baryonyx may take advantage of the latest technologies in wind generation which may become commercially available at the time of procurement. Turbines will be installed onto individual platform foundations attached to the seabed. Foundation type

US Army Corps
Of Engineers
Wilmington District

PUBLIC NOTICE

Issue Date: March 14, 2012
Comment Deadline: April 13, 2012
Corps Action ID #: SAW-2012-00040

The Wilmington District, Corps of Engineers (Corps) has received a proposal from the Village of Bald Head Island (VBHI) seeking Department of the Army authorization to construct a terminal groin structure on Bald Head Island, Brunswick, North Carolina.

Current plans and location information are described below and shown on the attached plans. This Public Notice and all attached plans are also available on the Wilmington District Web Site at www.saw.usace.army.mil/wetlands

Applicant:
Calvin Peck
Village of Bald Head Island
Post Office Box 3009
Bald Head Island, North Carolina 28461-7000

AGENT (if applicable):
Erik J. Olsen
Olsen Associates, Inc.
2618 Herschel Street
Jacksonville, Florida 32204

Authority

The Corps will evaluate this application and a decide whether to issue, conditionally issue, or deny the proposed work pursuant to applicable procedures of Section 404 of the Clean Water Act (33 USC 1344) and Section 10 of the River and Harbors Act.

Location

Bald Head Island is located in Brunswick County, North Carolina at approximately 33°51' N, 78°00' W (Figure 1.1). It is roughly 25 miles south of the City of Wilmington and 32 miles east of the South Carolina/North Carolina state line. It is the southernmost of the coastal barrier islands which form the Smith Island complex at the mouth of the Cape Fear River. The southeastern tip of the island is Cape Fear (also referred to as Cape Fear Point) from which Frying Pan Shoals extend seaward over 20 miles to the southeast.

The island's east and south shorelines, "East Beach" and "South Beach", front the Atlantic shoreline. The west shoreline, or "West Beach", fronts the Cape Fear River. A depositional spit feature known as the "Point" lies at the juncture of West Beach and South Beach (see Figure 1.2). The north side of the island is bounded by the Bald Head Creek estuary, Middle Island and Bluff Island. The Cape Fear River entrance, over one mile in width, separates Bald Head Island from Oak Island (or Caswell Beach).

Existing Site Conditions

A temporary sand-filled tube groin field was constructed by the VBHI along the westernmost portion of South Beach in March 1996, immediately following completion of a1996 dredge disposal project constructed by the Wilmington District. Sixteen groins (sand-filled tubes) were constructed of geotextile material and filled with sand. These temporary groins were replaced by the applicant in 2005 and in 2009.

According to the applicant, the island's gross volumetric sediment loss over the period from November 2000 to May 2011 (excluding East Beach) was approximately 4.363 M cy, or approximately 415,000 cy per year. During this period, the largest erosion impacts occurred at the extreme west end of South Beach bordering the Cape Fear River entrance. Since 2001, the Wilmington District has placed approximately 4.09 mcy on the South Beach shoreline from material dredged during the Cape Fear River channel deepening/widening project and two channel maintenance projects. In 2009, the VBHI dredged approximately 1.85 mcy from Jay Bird shoals and placed this material onto South Beach and West Beach. In July 2011, the VBHI constructed an extension to groin no. 16 (located closest to the Cape Fear River Entrance). The need for this structure was due to severe erosion on the downdrift side of groin #16. In December 2011, the VBHI constructed approximately 350 ft. of sand bag revetment located downdrift of groin no. 16. The purpose of this structure is to alleviate erosion impacts to the adjacent dunes, roads, homes, habitat, and infrastructure occurring downdrift of groin #16. The VBHI recently placed approximately 140,000 cy of material at the western end of South Beach. The source of material for this project was Bald Head Creek shoal.

According to the applicant, the island's gross volumetric sediment loss over the November 2000 to May 2011 timeframe (excluding East Beach) was approximately 4.363 M cy, or approximately 415,000 cy per year – on "average". Most of this loss occurred at the extreme West end of South Beach bordering the Cape Fear River entrance. The assignment of an average annual long-term rate of sand loss at Bald Head Island however, is not necessarily a meaningful indicator of "erosional stress". According to the applicant, such a "rate" is temporally biased by factors such as periods of beach fill equilibrationand groin field performance as well as other physiographic phenomena. Figure 3.1 depicts the location of the MHWL over the time span extending from November 2000 through May 2011. A portion of the South Beach shoreline retreated by as much as 400 ft. since 2000 despite placement (approximately 6 mcy) of sand on South Beach. According to the applicant, this magnitude of shoreline realignment can be addressed by its proposed terminal groin structure – with concurrent beach fill.

The Applicant contends that dredging of the Wilmington Harbor Entrance Channel by the Corps of Engineers has caused accelerated erosion on South Beach. The Corps of Engineers recognizes that the VBHI has experienced serious erosion and dramatic shifts in shorelines over many years; however, we do not concur that maintenance of the Wilmington Harbor Entrance Channel is the cause of that erosion.

Applicant's Stated Purpose

According to information provided by the applicant, the purpose of the proposed work is to address accelerating erosion at the western end of South Beach and to thereby protect public infrastructure, roads, homes, beaches, protective dunes and wildlife habitat,.

Project Description

The VBHI is proposing to construct a single terminal groin designed to compliment future placement of beach fill at South Beach. The structure will serve as a "template" for fill material placed eastward of the proposed terminal groin. The proposed terminal groin will be designed as a "leaky" structure (i.e. semi-permeable) so as to provide for some level of sand transport to West Beach (located northward of the proposed groin). According to the applicant, this magnitude of shoreline realignment, as discussed above, can be addressed by its proposed terminal groin structure – with concurrent beach fill.

Other Required Authorizations

This notice and all applicable application materials are being forwarded to the appropriate State agencies for review. The Corps will generally not make a final permit decision until the North Carolina Division of Water Quality (NCDWQ) issues, denies, or waives State certification required by Section 401 of the Clean Water Act (PL 92-500). The receipt of the application and this public notice combined with appropriate application fee at the North Carolina Division of Water Quality central office in Raleigh will constitute initial receipt of an application for a 401 Water Quality Certification. A waiver will be deemed to occur if the NCDWQ fails to act on this request for certification within sixty days of the date of the receipt of this notice in the NCDWQ Central Office. Additional information regarding the Clean Water Act certification may be reviewed at the NCDWQ Central Office, 401 Oversight and Express Permits Unit, 2321 Crabtree Boulevard, Raleigh, North Carolina 27604-2260. All persons desiring to make comments regarding the application for certification under Section 401 of the Clean Water Act should do so in writing delivered to the North Carolina Division of Water Quality (NCDWQ), 1650 Mail Service Center, Raleigh, North Carolina 27699-1650 Attention: Ms Karen Higgins by April 6, 2012.

The applicant has not provided to the Corps, a certification statement that his/her proposed activity complies with and will be conducted in a manner that is consistent with the approved North Carolina Coastal Zone Management Program. Pursuant to 33 CFR 325.2(b)(2), the Corps can not issue a permit for the proposed work until the applicant submits such a certification to the Corps and the North Carolina Division of Coastal Management (NCDCM), and the NCDCM notifies the Corps that it concurs with the applicant's consistency certification.

Essential Fish Habitat

This notice initiates the Essential Fish Habitat (EFH) consultation requirements of the Magnuson-Stevens Fishery Conservation and Management Act. The Corps' initial determination is that the proposed project may adversely impact EFH or associated fisheries managed by the South Atlantic or Mid Atlantic Fishery Management Councils or the National Marine Fisheries Service. The potential impacts to EFH associated with the proposed groin structure and concurrent beach fill are not known at this time.

Cultural Resources

The Corps has consulted the latest published version of the National Register of Historic Places and is not aware that any registered properties, or properties listed as being eligible for inclusion therein are located within the project area or will be affected by the proposed work. Presently, unknown archeological, scientific, prehistoric, or historical data may be located within the project area and/or could be affected by the proposed work.

Endangered Species

The Corps has reviewed the project area, examined all information provided by the applicant and consulted the latest North Carolina Natural Heritage Database. Based on available information, the Corps has determined pursuant to the Endangered Species Act of 1973 (ESA), that the proposed project may affect federally listed endangered or threatened species or their formally designated critical habitat. The potential impacts associated with the construction of the proposed project to federal species protected under the ESA are not known at this time. Consultation under Section 7 of the ESA will be initiated and no permit will be issued until the consultation process is complete.

Evaluation

The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity on the public interest.

That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, flood plain values (in accordance with Executive Order 11988), land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people. For activities involving the discharge of dredged or fill materials in waters of the United States, the evaluation of the impact of the activity on the public interest will include application of the Environmental Protection Agency's 404(b)(1) guidelines.

Commenting Information

The Corps of Engineers is soliciting comments from the public; Federal, State and local agencies and officials, including any consolidate State Viewpoint or written position of the Governor; Indian Tribes and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA). Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider the application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing. Requests for a public hearing shall be granted, unless the District Engineer determines that the issues raised are insubstantial or there is otherwise no valid interest to be served by a hearing.

Written comments pertinent to the proposed work, as outlined above, will be received by the Corps of Engineers, Wilmington District, until 5pm, April 13, 2012. Comments should be submitted to Dave Timpy, Project Manager, 69 Darlington Avenue, Wilmington, North Carolina, 28403, telephone (910) 251-4634.

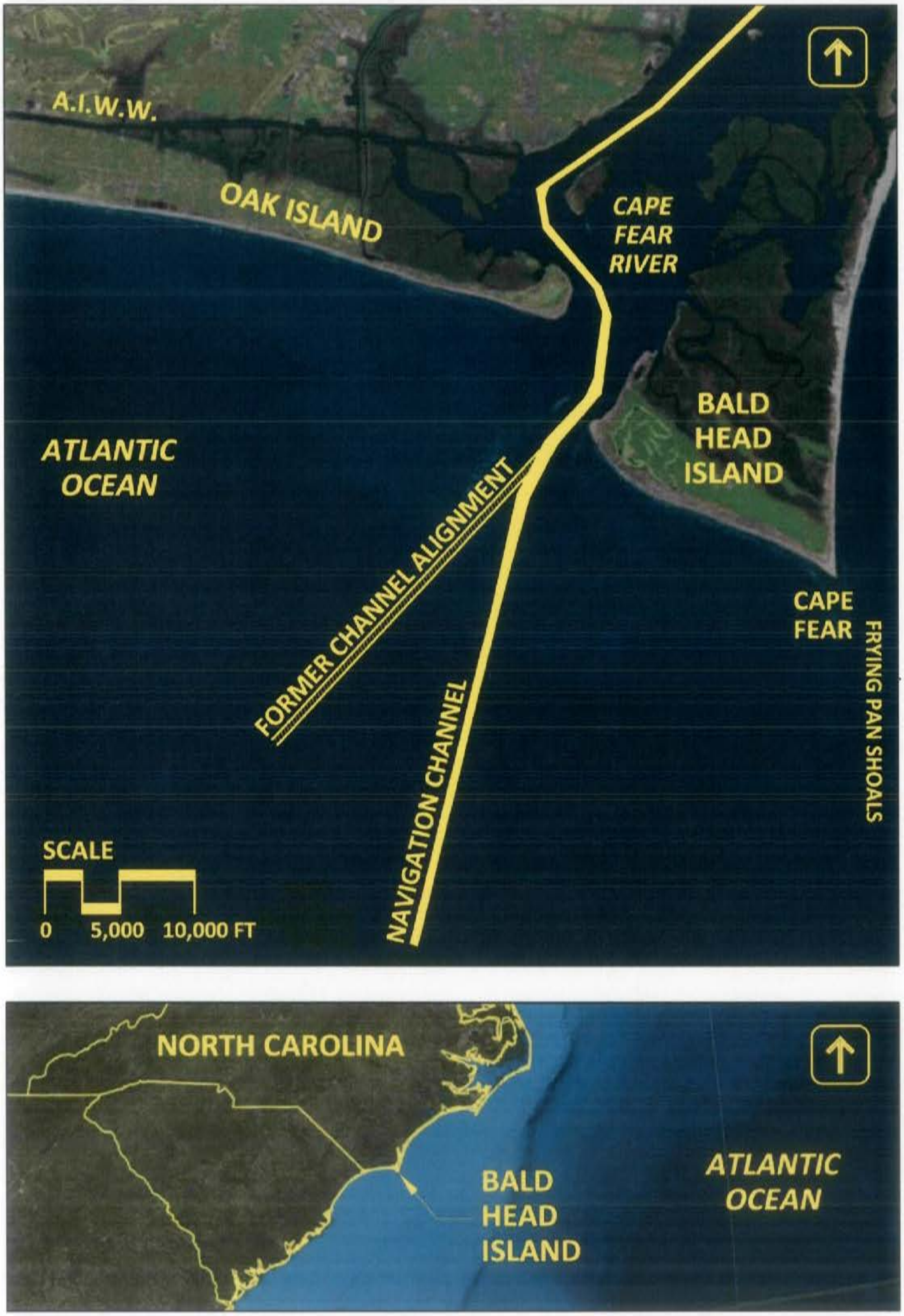

Figure 1.1: Location of Bald Head Island, N.C. and Federal Navigation Channel.

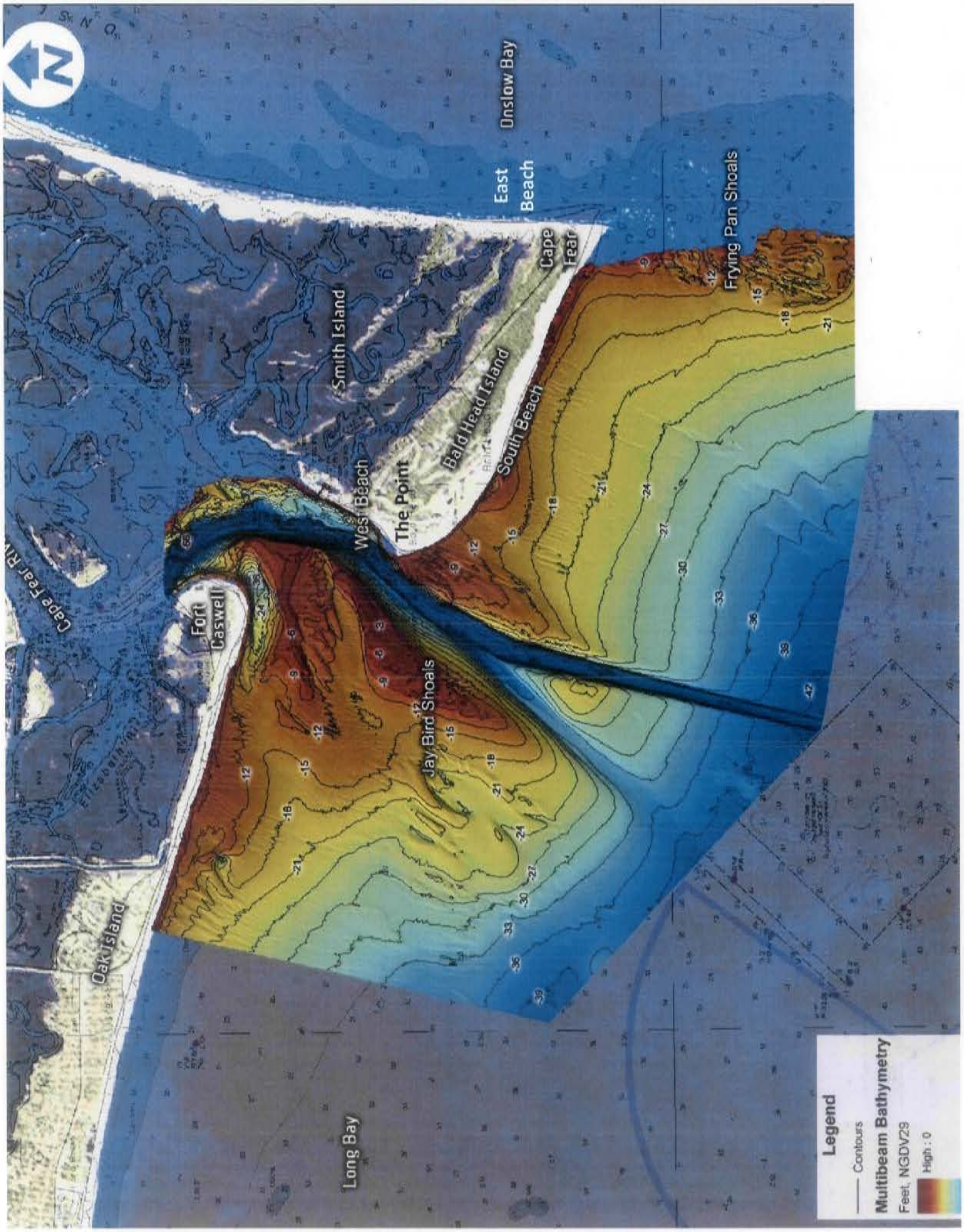

Figure 1.2: Bald Head Island/Oak Island/Cape Fear River.

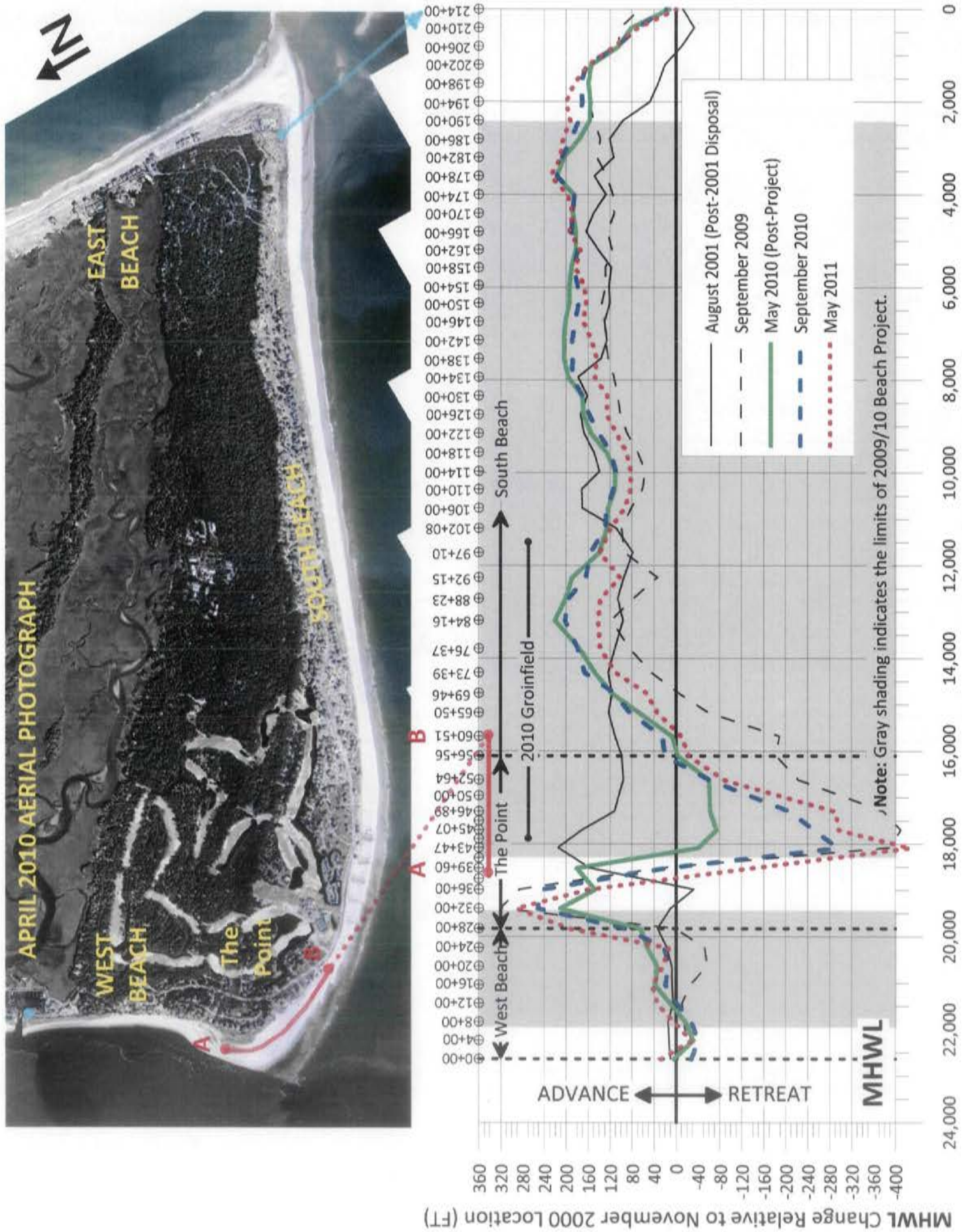

Figure 3.1: Location of the MHWL (+2.5 ft-NGVD) relative to the November 2000 survey.

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

May 11, 2012

Regulatory Division

Action ID No. SAW-2009-01242

Mr. Calvin Peck
Village of Bald Head Island
Post Office Box 3009
Bald Head Island, North Carolina 28461-7000

Dear Mr. Peck:

Reference our March 14, 2012 Public Notice describing the proposal by the Village of Bald Head Island to construct a shore protection project, including a terminal groin, on Bald Head Island, adjacent to the Northeast Cape Fear River, Brunswick County, North Carolina.

After review of your proposal, we have received comments from the North Carolina Division of Marine Fisheries (letter dated April 9, 2012), the North Carolina Division of Water Quality (letter dated March 21, 2012), the North Carolina State Historic Preservation Office (letter dated March 29, 2012), and the North Carolina Coastal Federation (letter dated April 12, 2012). Copies of all these letters are enclosed and have been previously provided to you by email. These comments and recommendations are due to anticipated adverse environmental impacts associated with your project.

Our administrative process provides you the opportunity to respond to the resource agency comments before we make a final permit decision. In this regard, please review the comments and recommendations and submit your written response to us on or before June 7th, 2012.

If you have questions or comments, please do not hesitate to contact me at telephone (910) 251-4634.

Sincerely,

Dave Timpy, Project Manager
Wilmington Regulatory Field Office

Enclosure

Copies Furnished (with enclosure):

Mr. Doug Huggett
Division of Coastal Management
North Carolina Department of
Environment and Natural Resources
400 Commerce Avenue
Morehead City, North Carolina 28557

Ms. Karen Higgins
Division of Environmental Management
North Carolina Department of
Environment and Natural Resources
1650 Mail Service Center
Raleigh, North Carolina 27699-1650

Mr. Ronald J. Mikulak, Chief
Wetlands Section - Region IV
Water Management Division
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, Georgia 30303

Mr. Pete Benjamin
U.S. Fish and Wildlife Service
Fish and Wildlife Enhancement
Post Office Box 33726
Raleigh, North Carolina 27636-3726

Mr. Ron Sechler
National Marine Fisheries Service
101 Pivers Island
Beaufort, North Carolina 28516

Ms. Rennee Gledhill Earley
North Carolina Department of Cultural Resources
State Historic Preservation Office
4617 Mail Service Center
Raleigh, North Carolina 27699

Ms. Anne Deaton
Division of Marine Fisheries
North Carolina Department of
Environment and Natural Resources
127 Cardinal Drive Extension
Wilmington, North Carolina 28405

Ms. Jessi Baker
Division of Marine Fisheries
North Carolina Department of
Environment and Natural Resources
127 Cardinal Drive Extension
Wilmington, North Carolina 28405

Ms. Deborah Wilson
Division of Coastal Management
North Carolina Department of
Environment and Natural Resources
127 Cardinal Drive Extension
Wilmington, North Carolina 28405

Molly Ellwood
Southeastern Permit Coordinator
North Carolina Wildlife Resources
Commission, Habitat Conservation Program
127 Cardinal Drive
Wilmington, North Carolina 28405

Christian Preziosi
Land Management Group, Inc
Post Office Box 2522
Wilmington, North Carolina 28402

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Marine Fisheries

Beverly Eaves Perdue
Governor

Dr. Louis B. Daniel III
Director

Dee Freeman
Secretary

MEMORANDUM:

TO: Dave Timpy, Project Manager, Wilmington USACE Regulatory Field Office

THROUGH: Anne Deaton, DMF Habitat Section Chief

FROM: Jessi Baker, DMF Habitat Alteration Permit Reviewer

SUBJECT: Village of Bald Head Island Terminal Groin Draft EIS - Scoping

DATE: April 9, 2012

The North Carolina Division of Marine Fisheries (DMF) submits the following comments pursuant to General Statute 113-131. Representatives from DMF attended an agency scoping meeting in Wilmington, NC for the Village of Bald Head Island (VBHI) terminal groin on March 28, 2012. DMF has reviewed the Corps of Engineers Public Notice and the Bald Head Island Terminal Groin Work Plan for installing a terminal groin. The VBHI proposes to install a terminal groin with supplemental beach nourishment at the west end of South Beach (or "The Point") at the southernmost extent of the existing sand bag groin field.

The 2010 Coastal Habitat Protection Plan (CHPP) summarizes the latest scientific information available to assess the status and threats to marine fish habitats. The CHPP process brings state regulatory agencies together to implement the recommendations from the CHPP. The CHPP states that research is needed to determine when and where recruitment to adult fish stocks is limited by larval ingress to estuarine nursery habitats. The CHPP also states that the long-term consequences of hardened structures on larval transport and recruitment should also be thoroughly assessed prior to approval of such structures. DMF has concerns that terminal groins will alter larval transport and impact important fish habitats through altered beach and nearshore sediment and profile.

Impacts to Larval Transport

Terminal groins can potentially interfere with the passage of larvae and early juveniles from offshore spawning grounds into estuarine nursery areas. Successful transport of larvae through the inlet occurs within a narrow zone parallel to the shoreline and is highly dependent on along-shore transport processes (Blanton et al. 1999; Churchill et al. 1999; Hare et al. 1999). Obstacles such as jetties adjacent to inlets block the natural passage for larvae into inlets and reduce recruitment success (Kapolnai et al. 1996; Churchill et al. 1997; Blanton et al. 1999) (from 2010 CHPP).

DMF requests a detailed scientific field investigation, analysis, and modelling of larval transport dynamics that exist around Bald Head Island. This information should be used to model estimated impacts of the groin to larval ingress and egress through the inlet.

Impacts to Fish Habitat

DMF has significant concerns about the use of hardened shoreline stabilization techniques along high energy ocean shorelines due to accelerated erosion in some location along the shore as a result of the longshore sediment transport being altered. These structures may also modify sediment grain size, increase turbidity in the surf zone, narrow and steepen beaches, and result in reduced intertidal habitat and diversity and abundance of macroinvertebrates. Anchoring inlets may also prevent shoal formation and diminish ebb tidal deltas, which are important foraging grounds for many fish species (Deaton et al. 2010). Changes to the surf zone or inlet could affect species that depend on these areas for nursery, spawning, or foraging.

DMF requests a field investigation of the current distribution of larval and juvenile fishes in the vicinity of the inlet and the proposed groin location. These data can identify the most highly utilized habitat areas as well as serve as baseline data to compare to larval and juvenile fish monitoring data that should be collected after groin construction.

Due to the potential for altered sediment grain size, beach profile and intertidal habitat due to the influence of a groin, DMF requests benthic macroinvertebrate monitoring within the impact area of the proposed groins.

Based on these concerns, DMF also requests detailed discussions of the following be included in the EIS.

- All Essential Fish Habitat (EFH)and state protected habitats that occurs in this area
- All fish habitats outlined in the most recent NC Coastal Habitat Protection Plan (CHPP) that occur in the area
- Characterization of and potential impacts to fish and invertebrate community composition and abundance in the inlet and adjacent surf zone at Bald Head Island
- Compilation of relevant research regarding larval transport through inlets, especially inlets with hardened structures
- Potential impacts to the benthos of the surf/swash zone and nearshore areas and a detailed plan to monitor for impacts within the impact area of the proposed groins
- Potential impacts to commercial or recreational fishing including any indirect economic impacts due to adverse impacts to fish and fish habitat
- Potential direct impacts from dredging, beach placement and nearshore placement of sand, and how those impacts will be minimized
- Potential impacts on regional sand budgets

If the USACE would like assistance in locating information regarding the above topics or has any other questions, please contact Jessi Baker at (252) 808-8064 or jessi.baker@ncdenr.gov.

One NorthCarolina Naturally

NCDENR

North Carolina Department of Environment and Natural Resources
Division of Marine Fisheries

Beverly Eaves Perdue
Governor

Dr. Louis B. Daniel III
Director

Dee Freeman
Secretary

MEMORANDUM:

TO: Dave Timpy, Project Manager, Wilmington USACE Regulatory Field Office

THROUGH: Anne Deaton, DMF Habitat Section Chief AD

FROM: Jessi Baker, DMF Habitat Alteration Permit Reviewer JB

SUBJECT: Village of Bald Head Island Terminal Groin Draft EIS - Scoping

DATE: April 9, 2012

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One NorthCarolina Naturally

2012-00140

NCDENR

North Carolina Department of Environment and Natural Resources

Division of Water Quality

Beverly Eaves Perdue
Governor

Charles Wakild, P.E.
Director

Dee Freeman
Secretary

March 21, 2012

DWQ Project # 12-0288
Brunswick County

CERTIFIED RETURN RECEIPT REQUESTED

Village of Bald Head Island
Calvin Peck
PO Box 3009
Bald Head Island, North Carolina 28461-7000

RECEIVED
MAR 2 6 2012
REG: WILM: FLD: OFC.

Subject Property: **Village of Bald Head Island – Terminal Groin Structure**

REQUEST FOR MORE INFORMATION

Dear Mr. Peck,

The Division of Water Quality (DWQ) received a Public Notice issued by the US Army Corps of Engineers on March 15, 2012. An Individual 404 Permit will be required for this project (SAW-2012-00040). Please note that the following must be received prior to issuance of a 401 Water Quality Certification.

Additional Information Requested:

1. The 401 Certification cannot be processed until five (5) complete sets of the application and associated maps are received at the DWQ Central Office in Raleigh along with the appropriate fee.
   Any large scale maps that are provided also need to include a copy of the site plans on a cd. One (1) data CD of full size plans in TIFF Group 4 format (black and white, <u>not</u> grayscale or color). If the plans are too large to store in TIFF format, they can be stored in PDF. If you have questions pertaining to this, please call Bev Strickland at (919) 807-6350.

2. Application Fee: The fee for applications is now $240 for projects impacting less than an acre of wetland and less than 150 linear feet of streams (whether intermittent or perennial). For projects impacting one or more acres of wetland or 150 linear feet of streams (whether intermittent or perennial), the fee is $570.

Until the information requested in this letter is provided, I will request (by copy of this letter) that the Corps of Engineers place this project on hold. Also, this project will be placed on hold for our processing due to incomplete information (15A NCAC 2H .0507(a)).

Thank you for your attention. If you have any questions, please contact me in our Central Office in Raleigh at (919) 807-6360 or Ian McMillan at (919) 807-6364.

Sincerely,

Karen A. Higgins, Supervisor
Wetlands, Buffers, Stormwater, Compliance and Permitting Unit (Webscape)

KAH/*ljd*

cc: USACE Wilmington Regulatory Field Office
Olsen Associates, Inc., Erik J Olsen, 2618 Herschel St, Jacksonville FL 32204
File Copy

Filename: 120288VBHITerminalGroinStructure(Brunswick)_Hold_ IP_NeedSets_Fee

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

RECEIVED
MAY 18 2012
REG. WILM. FLD. OFC.

May 14, 2012

Mr. David Timpy
U. S. Army Corps of Engineers
Wilmington Regulatory Field Office
P. O. Box 1890
Wilmington, North Carolina 28402-1890

Subject: Action ID #SAW- 2012-00040; Village of Bald Head Island
Brunswick County, NC

Dear Mr. Timpy:

This letter provides the comments of the U. S. Fish and Wildlife Service (Service) on the subject Public Notice (PN), dated March 14, 2012, and in response to a request for comments at the April 24, 2012 Project Delivery Team (PDT) meeting. The applicant, the Village of Bald Head Island (VBHI), has applied for a Department of the Army (DA) permit to construct a terminal groin structure on Bald Head Island in the Atlantic Ocean. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d). Comments related to the FWCA are to be used in your determination of compliance with 404(b)(1) guidelines (40 CFR 230) and in your public interest review (33 CFR 320.4) in relation to the protection of fish and wildlife resources. Additional comments are provided regarding the District Engineer's determination of project impacts pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543).

Project Area, Proposed Activities, and Anticipated Impacts

The project area is South Beach and the adjacent Atlantic Ocean on Bald Head Island. The waters of the project area are classified as SB. The area is not designated as a Primary Nursery Area (PNA) and is not closed to the taking of shellfish. The substrate of the project area is primarily sand.

The applicant proposes to construct a single terminal groin, to complement future placement of beach fill at South Beach. The groin is intended to be a "leaky" structure, so as to provide for a level of sand transport to West Beach, which is located northward of the proposed groin. According to information provided at the April 24, 2012 PDT meeting, the groin is proposed to be constructed in "the dry." In other words, the applicant proposes to place the sand first on the nearshore area, and then construct the terminal groin. The applicant states that the nourishment portion of the project is proposed to be conducted during the sea turtle nesting season.

Federally Protected Species

The Service has reviewed available information on federally-threatened or endangered species known to occur in Brunswick County. Our review indicates that several species may occur in the project area, including the West Indian manatee (*Trichechus manatus*), piping plovers (*Charadrius melodus*), seabeach amaranth (*Amaranthus pumilus*), and the Kemp's Ridley (*Lepidochelys kempi*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), and green (*Chelonia mydas*) sea turtles. Of the five sea turtle species, the loggerhead (*Caretta caretta*), and green (*Chelonia mydas*) sea turtle may nest in the project area. Whales, shortnose sturgeon (*Acipenser brevisrostrum*), Atlantic sturgeon (*Acipenser oxyrinchus*), and sea turtles in the water are under the jurisdiction of NOAA Fisheries' Protected Species Division.

Manatees move along the Atlantic Coast during summer months and are seasonal transients in North Carolina, primarily from June through October. Manatees may be found in water over one meter (3.3 feet) deep. The species moves extensively when in North Carolina waters and past occurrence records cannot be used to precisely determine the likelihood that it will be present at a particular construction site.

Seabeach amaranth, an annual plant, exists adjacent to inlets, along beaches between dunes and the high tide line, and in areas of extreme overwash. The plant helps to trap sand and build dunes. The species is listed as threatened by both the federal government and the State of North Carolina. Suitable habitat for this plant occurs in the project area. Seabeach amaranth begins to flower as soon as plants have reached sufficient size, sometimes as early as June, but more typically commencing in July and continuing until the death of the plant in late fall. Seed production begins in July or August and peaks in September during most years, but continues until the death of the plant. The proposed work period would place sand on the beach when only seeds are present. Sediment placement may bury seeds on the beach and delay germination the following year, but the seeds are likely to remain viable and may germinate when the imported sand washes away.

Piping plovers, designated as federally threatened, are known to occur in the project area, but there is no designated critical habitat on Bald Head Island. Piping plovers nest above the high tide line on coastal beaches; on sand flats at the ends of sand spits and barrier islands; on gently sloping foredunes; in blowout areas behind primary dunes (overwashes); in sparsely vegetated dunes; and in overwash areas cut into or between dunes. The species requires broad, open, sand flats for feeding, and undisturbed flats with low dunes and sparse dune grasses for nesting. Piping plovers from the federally endangered Great Lakes population as well birds from the threatened populations of the Atlantic Coast and Northern Great Plains overwinter on North Carolina beaches. Piping plovers arrive on their breeding grounds in late March or early April. Following establishment of nesting territories and courtship rituals, the pair forms a depression in the sand, where the female lays her eggs. By early September both adults and young depart for their wintering areas.

Service Concerns and Recommendations

As stated above, the applicant states that the nourishment portion of the project is proposed to be conducted during the sea turtle nesting season. It is also likely that the proposed window for beach nourishment includes the nesting period for piping plovers. The Service recommends that the environmental document(s) clearly discern the proposed timeframes for beach nourishment and potential impacts to nesting sea turtles, the West Indian manatee, seabeach amaranth, and piping plovers. Potential impacts to these species on Oak Island should also be fully considered. The environmental document(s) should discuss the potential impacts that may occur if sediment disposals associated with the Wilmington Harbor Sand Management Plan (SMP) occur on Oak Island within the same year.

Section 4.4 of the January 2012 NEPA/EIS work plan states "the proposed structure will be designed to be strategically incorporated into the beach disposal operations associated with the Wilmington Harbor Sand Management Plan. The latter program provides the equivalent of 1 M cy of high quality sand every two years. It is anticipated that construction of the proposed structure would be timed sufficient to take advantage of the beach disposal event's ability to fill the terminal groin to capacity so as to minimize the probability of downdrift impacts after installation." However, as mentioned above, the applicant stated at the April 24, 2012 meeting that the beach is proposed to be nourished before the groin is constructed. The EIS should outline the proposed construction logistics and timelines, and examine whether the available sources of sand are adequate to meet the proposed method and schedule of construction. The environmental documents should also examine the long-term effects to the listed species listed above from the proposed beach nourishment schedule (every two years).

Potential impacts to the levels of erosion on Oak Island and West Beach from the construction of the terminal groin should be fully examined in the environmental documents. The analysis should include how potential impacts to Oak Island will affect listed species.

The Cumulative Impacts Analysis should include an analysis of potential sea-level rise scenarios (similar to what is required by Engineer Circular EC 1165-2-211), and the potential influence that sea-level rise will have on the structural integrity of the terminal groin and the nourishment schedule during the proposed life of the project.

Summary

The Service appreciates the opportunity to comment on this PN. We look forward to working with the Project Development Team (PDT) to review the EIS/EA and Biological Assessment. If you have questions regarding these comments or wish to discuss the development of the coordinated federal position, please contact Kathy Matthews at 919-856-4520, ext. 27 or by e-mail at <kathryn_matthews@fws.gov >.

Sincerely,

Peter Benjamin
Field Supervisor

cc:

Ron Sechler, NOAA Fisheries, Beaufort
Molly Ellwood , NC Wildlife Resources Commission, Wilmington
Doug Huggett, NC Division of Coastal Management, Morehead City
Jessi Baker, NC Division of Marine Fisheries, Wilmington
Chad Coburn, NC Division of Water Quality, Wilmington

North Carolina Coastal Federation
CITIZENS WORKING TOGETHER FOR A HEALTHY COAST
Celebrating 30 Years of Coastal Conservation
1982-2012

April 12, 2012

Dave Timpy
Project Manager
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403-1343

Re: Village of Bald Head Island Terminal Groin Scoping Comments: Corps Action ID#: SAW-2012-00040

Dear Mr. Timpy:

Please accept these comments regarding the needed scope of the Environmental Impact Statement (EIS) that will be prepared to evaluate a possible terminal groin at the Village of Bald Head Island to address the erosion at the western end of South Beach. These comments are based upon the federation's experience with beach and inlet management in North Carolina, and participation in the development of numerous environmental reviews for beach and inlet management projects. In addition, our direct participation in the development of terminal groin legislation in North Carolina during 2011 (NC General Assembly Senate Bill 110) as well as at the scoping meeting held by the Corps on March 8, 2012, allow us to provide some insights into issues that need to be thoroughly vetted by this environmental analysis.

To provide adequate and useful information to federal and state agencies to make permit decisions regarding this proposed project, the federal EIS that is ultimately prepared for this project must address and resolve significant regulatory requirements that are specified in the terminal groin law enacted in 2011 by the North Carolina General Assembly. This law is being incorporated into the federally approved coastal plan for North Carolina, and therefore, there is an obligation by all federal agencies to act in a manner consistent with the state's plan as mandated by the Coastal Zone Management Act of 1972.

Fortunately, the Council of Environmental Quality's (CEQ) guidelines call for detailed descriptions of proposed alternatives as well as for a thorough explanation of their rejection (CFR 40 § 1502.14(a-f)). This is further supported by the NCGS § 113A-4 that defines the information the state agency needs to include in an EIS to satisfy state environmental review requirements. Similarly, the NCGS § 113 A – 115.1 (e)(1) requires the applicant for the permit to submit "information to demonstrate that ... non structural approaches to erosion control including relocation of threatened structures, are impractical." Under state law, no permit for a terminal groin can be issued if nonstructural alternatives are practical and will achieve the project's purpose.

The applicant's stated purpose of the project is to implement an erosion control and beach/dune restoration that will provide long-term protection to residential structures and Town infrastructure along the western end of South Beach. The applicant also states the project would be expected to complement existing island wide nourishment activities and is expected to protect town infrastructure, roads, homes, beaches, protective dunes and wildlife habitat.

The project description is troublesome in that the applicant clearly states its preferred alternative before any alternatives have been thoroughly investigated and discussed during the formal EIS process. It would seem reasonable to limit the project's purpose as stated in the public notice, and vet all alternatives prior to selection of the preferred alternative by the applicant. The description of the project purpose in the Corps public notice dated March 14, 2012 would provide that overall general purpose of the applicant but it instead takes the leap from that stated purpose to the specific alternative of a terminal groin which would seem to prejudice the project's stated purpose from the beginning.

Clearly other alternatives must be evaluated, and non-structural alternatives may be much more practical once the total benefits and costs of this project are more fully understood. Other communities have selected to pursue non-structural alternatives to achieve similar project purposes. For example, the Town of North Topsail Beach has chosen the option of inlet channel relocation over the one of building a terminal groin. Similar inlet channel relocation projects have been permitted in the past at both Mason and Bogue Inlets.

In addition, the applicant also needs to provide detailed information necessary to "demonstrate that structures or infrastructures are imminently threatened by erosion." [NCGS § 113 A – 115.1 (e)(1))]. According to 15A NCAC 07H.0308, imminently threatened structures are defined as those which "foundation, septic system, or right-of-way in the case of roads, is less than 20 feet away from the erosion scarp." The actual number and location of structures that qualify as "imminently threatened" based upon the rules of the Coastal Resources Commission need to be identified.

In relation to the latter it is paramount for the applicant to demonstrate that "the construction and maintenance of the terminal groin will not result in significant adverse impacts to private property or to the public recreational beach" [NCGS § 113 A – 115.1 (f)(4)]. In order to comply with this requirement the applicant needs to identify what constitutes a significant "negative" impact that must be mitigated as well as what boundaries (and specifically why certain boundaries are chosen over others) the applicant is considering when demonstrating lack of significant adverse impacts.

NCGS § 113 A – 115.1 (f)(5) also requires the post-project monitoring and necessary mitigation. To comply with this the project application must show one crucial component

- the definition of thresholds. This definition will serve the dual purpose: serve as a baseline for determining mitigation of any future adverse impacts; and serve as a baseline for future monitoring. Shifting baselines, a widely accepted term among scientific community, is used to describe ways in which significant changes in a system are measured against previous reference points or baselines. Failure to identify correct baseline can significantly affect future assessment of not only monitoring of natural systems, but also of mitigation of the adverse impacts to the natural system and private property as well.

The federation suggests that the thresholds be determined based upon the predictions of future shoreline and inlet configurations that are associated with each individual project alternative identified in the EIS. In order to demonstrate that non-structural alternatives are impractical, the EIS must clearly prove that a terminal groin will result in more beneficial shoreline and inlet configurations that cost-effectively accomplish the project purposes. This means the terminal groin alternative must then deliver on what the applicant promises since any future shoreline and inlet configurations that could have been achieved with a non-structural alternative constitute unacceptable performance by the terminal groin. Therefore, the thresholds for mitigation of unacceptable impacts caused by the preferred alternative are any actual beach and inlet configurations that could have been achieved by using a non-structural alternative or no action.

In evaluating the costs and benefits of various project alternatives, the applicant should represent scenarios that include the effects of storms on the project area. The applicant should compare the effects of storms on the project area with a terminal groin, with non-structural alternatives, and with no action. If the applicant is unable to account for the effects of storms in predicting and comparing project benefits and costs among various alternatives, then the state law will make the applicant liable for future damages that result from storms once the terminal groin is constructed. In other words, if the EIS indicates that the terminal groin will protect property, and property--supposedly protected is later lost during a storm--that constitutes a project failure unless those losses are not accounted for upfront in the analysis of alternatives.

According to National Atmospheric and Oceanic Administration and the U.S. Geological Service, recent data show that the coast of North Carolina will likely be affected by more than 60 hurricanes in a 100-year period. It is, therefore, reasonable to assume that the proposed project will be affected by at least one major storm with catastrophic consequences over its projected lifetime (which in the case of terminal groins is 30 years). The CEQ defines those “impacts which have catastrophic consequences, even if their probability of occurrence is low” as “reasonably foreseeable” (CFR 40 § 1502.22(b)(4), and hence requires to the applicant to include them in the EIS. Therefore, the applicant should account for the impacts of storms when drafting the EIS for the proposed project.

State law requires that the applicant for a terminal groin submit proof of financial assurance (bond, escrow account or other financial instrument) that can cover the costs of monitoring and maintenance, implementation of mitigation measures and modification and/or removal of the structure, as well as of restoration of public and private property negatively affected by the structure. These exact costs of this bond, insurance policy, or escrow account need to be determined so they can be factored into the cost/benefit analysis that is done as part of the alternatives analysis. Additional project costs that need to be determined include the increased commitment to beach nourishment near the inlet as well as inlet management costs and how the proposed terminal groin will affect the inlet as well as the inlet inner beaches and estuarine ecosystems. Also, the EIS should detail the costs of preparing the EIS, obtaining permits, and expected legal proceedings since any permitting around this issue is likely to be challenged through the courts. These total costs of the project are necessary to fully evaluate project alternatives, and especially to determine if the terminal groin option is practical, feasible, and cost-effective.

Below is a list of other information and issues that the EIS should address:

- The CRC terminal groin report dated March 1, 2010 recommended strategies other than hardened structures to protect beaches and manage inlets should always be considered first. To comply with state policy, investigating non-structural alternatives should be the main objective of this analysis, not rationalizing the construction of a terminal groin. Non-structural approaches to erosion control include inlet channel relocation, beach nourishment, relocation of structures and relocation of power, water and sewer infrastructure in a manner and location to protect such infrastructure and public health and safety.
- Jurisdictional 404 wetlands throughout the project area must be identified and mapped. This area includes both sides of the inlet. Any impacts to jurisdictional wetlands need to be evaluated, and compliance with avoidance, minimization and mitigation requirements explained for each project alternative.
- “Critical habitat” as defined by the US Fish and Wildlife Service needs to be mapped on both sides of the inlet. The effects of the project alternatives need to be evaluated on this habitat. There now seems to be a general agreement by some regulators and agencies that some protected species, such as the federally listed endangered Piping Plover, can adapt to changes in its required habitat and “find new places to live” are troublesome to say the least. Critical habitats must be identified and protected as much as reasonably possible due to any impacts of proposed beach erosion measures.
- Structures or infrastructures that are imminently threatened by erosion” as defined by 15A NCAC 07H.0308 need to be identified and mapped. “Imminently threatened structures” are defined as those which “foundation, septic system, or right-of-way in the case of roads, is less than 20-feet away from the erosion scarp.”
- A plan for construction and maintenance of the proposed terminal groin and its accompanying beach fill project that is prepared by a professional engineer licensed to practice in North Carolina must be provided as part of the terminal groin option (NCGS § 113 A – 115.1(e)(4)).

- A plan for the management of the inlet and the estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet must be provided. The inlet management plan shall do all of the following relative to the terminal groin alternative and its accompanying beach fill project (NCGS § 113 A – 115.1 (e)(5)):
  - Describe the post-construction activities that the applicant will undertake to monitor the impacts on coastal resources.
  - Define the baseline for assessing any adverse impacts and the thresholds for when the adverse impacts must be mitigated. (These thresholds should correlate with the various alternatives evaluated by the EIS, and any performance of the terminal groin alternative that could have been achieved by a non-structural alternative should be identified as an "adverse impact.")
  - Identify mitigation measures to be implemented if adverse impacts reach the thresholds defined above, and state the costs of these mitigation measures.
  - Provide for modification or removal of the terminal groin if the adverse impacts cannot be mitigated and the costs for these modifications and removal.
- Under each possible project alternative, identify those property owners and local governments on both sides of the inlet that may be affected.
- Identify funding sources necessary to fund the terminal groin and beach fill alternative (including the costs of developing this EIS and obtaining permits) over its design life given that no state funds are available for these projects, and local funds spent on these projects by a local government need voter approval. No permits for Terminal groins can be issued in North Carolina where funds are generated from any of the following financing mechanisms and would be used for <u>any activity related to the terminal groin or its accompanying beach fill project</u> (NCGS § 113 A – 115.1 (h)):
  - Special obligation bonds issued pursuant to Chapter 1591 of the General Statutes.
  - Nonvoted general obligation bonds issued pursuant to G.S. 1590148.
  - Financing contracts entered into under G.S. 160A-20 or G.S. 159-148.
- The applicant must provide cost estimates for the required financial assurances specified by state law for a terminal groin project. These assurances must be in the form of a bond, insurance policy, escrow account or other financial instrument, that is adequate to cover the cost of:
  - Removal of the terminal groin and restoration of the beach if it is determined by an independent third party that the groin has an adverse impact on the environment or on other properties, and;
  - Removal of the terminal groin and restoration of the beach if it is determined that the groin has an adverse impact on the environment or on other properties and on the federal navigation channel, and;
  - Long-term maintenance of the terminal groin, including the cost of any required mitigation measures and compliance with all conditions of the permit and variance.

- Detailed information about storm impact and effects upon the terminal groin and also on the inlet dynamics and morphology, the beach profile, sand resources, residential structures, private property, adjacent properties, and the natural resources and environment of the permit area due to the placement of the terminal groin.
- Detailed information and modeling on the impacts of sea level rise on the terminal groin and the resulting effects upon inlet dynamics, adjacent property, beach profiles, residential structures and the natural resources and environment of the island and adjacent islands and estuarine habitats and resources.
- The development of accurate cost-benefit analysis to ensure the costs of storm events is appropriately considered and modeled using real world and real time property appraisals for all project alternatives. The high risk of significant storm damage to beach front properties should be part of the cost-benefit analysis and used to discount the project benefits for each possible alternative considered.
- The economic costs and benefits of each project alternative should include the positive economic values associated with natural inlet processes (fishing, tourism, habitat creation, and larvae transport and fish migration).
- Detailed study and modeling of the effect of any proposed terminal groin on the inlet dynamics, which increase the frequency of, needed dredging and could have long-term negative impacts upon the structure itself and on adjacent shorelines both east and west of the groin. The effect of the groin on inlet narrowing and loss of natural inlet shoals and sand flats should be investigated as well at the possible increase in tidal flow due to inlet morphology changes.
- Thorough modeling of the effects of the terminal groin on the ebb shoal deflation should be considered along with both the economic and resource related costs. This loss of sediment volume could steepen the near shore beach profiles and in turn increase the wave energy reaching the coast and inner inlet areas.
- Thorough modeling of the effects of the terminal groin on the navigation channel and the effects of the continued required navigation channel maintenance and dredging on the integrity of the terminal groin itself and its proposed functions and purported benefits.
- Incorporation of the state Beach and Inlet Management plan into the EIS process and consideration of those recommendations for avoidance of hardened structures on the beach.
- Consideration of the proposed terminal groin and its possible effects of reducing the long shore transport of sediment to the area identified as “West Beach” and how that reduction of sediment will affect erosion or accretion at that location as and that potential effect upon the areas natural resources and public and private infrastructure.
- Identification of the purpose and need to keep the existing permitted sand filled tube groins in addition to the construction of a terminal groin as proposed. Detailed analysis of the success or failure of the permitted sand groins and detailed modeling of the effects of the terminal groin with the sand groins removed and kept upon the affected areas and requested terminal groin.
- Consideration of the proposed terminal groin and its possible effect upon the east end of Oak Island, the historic sites, public and private property. Detailed

modeling should be required to review the possible effects of the proposed groin upon the federal navigation project and detailed modeling and monitoring of any impacts upon that public project as a result of a terminal groin.

- The effects of the terminal groin on the critical piping plover habitat on each side of the inlet must be evaluated. How the project will comply with the Endangered Species Act must be addressed.
- The potential effects of the terminal groin upon the just listed Atlantic Sturgeon on the federal Endangered Species Act and upon the Short Eared Sturgeon, Eastern Manatee and other endangered marine life that utilize the Cape Fear River and inlet channel in their life cycle.
- The effects of the terminal groin upon endangered sea turtle habitat on both Bald Head Beaches and beaches at Oak Island should be thoroughly researched and analyzed.
  -The potential effects of the design of the proposed terminal groin as a "leaky" structure should be researched and analyzed and how any injury or death will be avoided due to the leaky structure design from trapping sea turtles and other critical marine and mammals within the groin itself.
- - How will both adult and hatching sea turtles survive storm and wave action in and around the terminal groin?
- The proposed terminal groin is described as a leaky structure. Detailed description of that structure should include it's "leakage" rate and how that will affect the required beach nourishment and identify milestones that should be established to address the groin's leakage rate. How will this leakage rate affect the use of the public beach and its affect upon the natural resources of the beach community? How will the leakage rate affect erosion or accretion on the "West Beach" area and how will that leakage rate be calculated.
- Consideration of the gradual blockage of the "leaky" groin due to growth of marine life, debris and other impediments and what measures and strategies will be designed to address this possibility.
- The potential effects of the groin upon the Cape Fear River inlet system, tidal flow and fish migration should be investigated as well as the effects upon Jaybird shoals and essential fish habitat identified in the inlet system.
- Proof and analysis that a terminal groin will reduce the frequency of required beach nourishment and address how the proposed "leaky" structure will affect that required frequency.
- A terminal groin could negatively affect an inlet's equilibrium and its ability to maintain a sediment balance. This could result in more manipulation of the inlet and associated costs to the overall long-term project. These long-term management costs need to be determined and factored into the alternatives analysis.
- One option that is not addressed in the proposal is to augment or enhance and improve the current permitted sand filled tubes to address the erosion issues and perform a detailed analysis of the sand filled tube groin field success and how those permitted structures could be revised to fulfill the projects stated purpose.
- If the permitted sand filled groin field is allowed to remain and a terminal groin is permitted will that violate the intent and language of Senate Bill 110? According

to the approved legislation only one terminal groin will be permitted at the end of a barrier island. The 16 sand filled groins, if left on the public beach, might violate the intent and spirit of the approved legislation. A legal opinion of this issue should be considered by the state and the Coastal Resources Commission.

The Federation has serious concerns about the proposed terminal groin project at Bald Head Island. A careful analysis of alternatives that are evaluated based upon the requirements established by the NC General Assembly are likely to show that non-structural alternatives are more cost-effective and practical. The Corps must ensure that the EIS addresses these explicit state mandates since they are part of the state's coastal management requirements and program.

We appreciate the opportunity to comment and be involved in this project. Please do not hesitate to contact us if you have any questions of need any clarification of these preliminary comments. We intend to fully participate in the development of this EIS, the review of project permits, and any court proceedings that might follow.

With best regards,

Mike Giles

Mike Giles
Coastal Advocate

Ana Zivanovic-Nenadovic
Program and Policy Analyst

North Carolina Department of Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

RECEIVED
MAR 30 2012
REG. WILM. FLD. OFC.

March 29, 2012

Dave Timpy
US Army Corps of Engineers
Wilmington Regulatory Field Office
69 Darlington Avenue,
Wilmington, NC 28403

Re: Construction of a Terminal Groin at the Juncture of Bald Head Island and the Entrance to the Cape Fear River, SAW 2012-00040, Brunswick County, ER 12-0437

Dear Mr. Timpy,

We have reviewed the above public notice concerning proposed plans to construct a terminal groin at the juncture of Bald Head Island and the entrance to the Cape Fear River. Your agency and the applicant should be aware that the Office of State Archaeology underwater research files have references to extensive maritime activities and shipwreck losses in the general project vicinity; therefore, much of the project area holds a high potential for containing submerged cultural resources. Three known shipwrecks (*La Rosa de Bilbao*, 1804; *Ella*, 1864; USS *Violet*, 1864) and two probable shipwrecks are located within less than one mile of the proposed groin.

While no known archaeological sites are within the project boundaries, the project area has never been systematically surveyed to determine the location or significance of submerged cultural resources. As the project creates a bottom disturbance that may damage unknown elements of our underwater cultural heritage we recommend that a comprehensive survey be conducted by an experienced archaeologist to identify the presence and significance of submerged archaeological remains lying within the project boundaries. Potential effects on these resources should be assessed prior to the initiation of construction activities.

A list of archaeological consultants who have conducted or expressed an interest in contract work in North Carolina is available at http://www.archaeology.ncdcr.gov/ncarch/resource/consultants.htm. The archaeologists listed, or any other experienced archaeologist, may be contacted to conduct the recommended investigation.

These comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, North Carolina legislation (G.S. 121-22 to 28, Article 3), and the Abandoned Shipwreck Act of 1987 (P.L. 100-298).

We have determined that the project as proposed will not have an effect on any historic structures.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above referenced ER tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

cc: Calvin Peck, Village of Bald Head Island
Eric Olsen, Olsen Associates, Inc.

RECEIVED
MAR 30 2012
REG. WILM. FLD. OFC.

RECEIVED
JAN 2 2 2013

North Carolina Department of Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Pat McCrory, Governor
Susan W. Kluttz, Secretary
Kevin Cherry, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

January 17, 2013

Dave Timpy
US Army Corps of Engineers
Wilmington Regulatory Field Office
69 Darlington Avenue,
Wilmington, NC 28403

Re: Construction of a Terminal Groin at the Juncture of Bald Head Island and the Entrance to the Cape Fear River, SAW 2012-00040, Brunswick County, ER 12-0437

Dear Mr. Timpy,

We have received the archaeological survey report "A Phase I Remote-Sensing Archaeological Survey & Phase II Shipwreck Assessment at the Location of a Proposed Terminal Groin at the Mouth of the Cape Fear River, Bald Head Island, Brunswick County, North Carolina" from Tidewater Atlantic Research, Inc. (TAR) for the above project. The report meets our office's guidelines and those of the Secretary of the Interior and we would like to take this opportunity to comment.

The terrestrial and underwater survey conducted by TAR identified 104 magnetic anomalies and two acoustic targets. A cluster of four magnetic anomalies (86, 89, 90, and 93) associated with one acoustic signature were generated by the remains of a vessel requiring additional archaeological investigation. The remaining targets were determined to not warrant further investigation.

A Phase II non-disturbance investigation of the shipwreck remains, determined it to be a large wood hull sailing vessel dating to the late 19^{th} or early 20^{th} century. This shipwreck is deemed potentially eligible and requires avoidance. Because the wreck is located within 70 feet of the proposed groin location, TAR proposed a shift in the construction alignment to provide a minimum 150 foot buffer. We concur with this recommendation that a 150 foot buffer is required around the wreck location. Additionally, during construction all contractors should be made aware of the location of the wreck and provide assurance that vessels and equipment engaged in construction of the groin will not infringe on the buffer created, to preserve the surviving vessel remains.

These comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, North Carolina legislation (G.S. 121-22 to 28, Article 3), and the Abandoned Shipwreck Act of 1987 (P.L. 100-298).

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above referenced ER tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

cc: Chris McCall, Village of Bald Head Island
Eric Olsen, Olsen Associates, Inc.

Village of Bald Head Island Shoreline Protection Project - Scoping Comment Table

No.	Nature of Comment (Summary)	Agency/Entity	Category	Inclusion in DEIS
1	Limit project purpose as stated in public notice and vet all alternatives prior to selection of applicant's preferred alternative	NCCF	Alternatives Analysis	Sections 1.0 and 3.0
2	Provide detailed information necessary to "demonstrate that structures or infrastructures are imminently threatened by erosion"	NCCF	SB 110 State Regulation	Section 4.0 provides information to demonstrate that structures are threatened by erosion
3	Define mitigation thresholds and correct baseline/boundaries for determining mitigation	NCCF	SB 110 State Regulation	Inlet Management Plan (Appendix B)
4	Include information on impacts of storms on terminal groin and project area	NCCF	Meteorological/Storm	Storm Response Simulation (Appendix P)
5	Determine costs of financial assurance (bond, escrow account, insurance policy) and include cost/benefit analysis as part of alternatives analysis	NCCF	Financial/Economic	Beyond Scope of EIS
6	Include costs of preparation of document, obtaining permits and expected legal costs if final permit is challenged through the courts	NCCF	Financial/Economic	Beyond Scope of EIS
7	Investigate non-structural alternatives prior to rationalization of construction of terminal groin (ie. inlet channel relocation, beach nourishment, relocation of structure and infrastructure	NCCF	Physical	Section 3.0
8	Identify and map 404 wetlands on both sides of inlet, evaluate impacts of project alternatives on resource	NCCF	Wetlands	Section 4.0 (Bald Head Island wetlands), Oak Island wetland delineation beyond scope of EIS
9	Identify and map "critical habitat" as defined by USFWS on both sides of inlet, evaluate impacts of project alternatives on resource	NCCF	Habitat	No USFWS Critical Habitat in project area
10	Identify and map structures and infrastructure "imminently threatened by erosion" as defined by 15A NCAC 07H.0308	NCCF	Public/Private Property	Section 5.0 and Figures 5.30-5.37
11	Professional engineer licensed in NC should prepare plan for construction and maintenance of proposed terminal groin and accompanying beachfill project	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013)
12	Include "inlet management plan" for inlet, estuarine and ocean shorelines adjacent to and under influence of inlet	NCCF	SB 110 State Regulation	Inlet Management Plan (Appendix B)
13	Identify property owners and local governments on both sides of inlet that may be impacted for each project alternative	NCCF	Public/Private Property	CAMA Major Application

Village of Bald Head Island Shoreline Protection Project - Scoping Comment Table

No.	Nature of Comment (Summary)	Agency/Entity	Category	Inclusion in DEIS
14	Identify funding sources for terminal groin and beachfill alternative assuming no state funds available and voter approval necessary for local government funding	NCCF	Financial/Economic	Not currently addressed
15	Provide cost estimates for required financial assurances specified by state law including removal of terminal groin/restoration of beach and long term maintenance of terminal groin	NCCF	Financial/Economic	Economic considerations identified in Section 5.14
16	Include information on potential storm impacts to inlet dynamics/morphology, beach profile, sand resources, residential structures, private property, adjacent property and natural resources in permit area	NCCF	Meteorological/Storm	Refer to Engineering Report
17	Include information and model of impacts of sea level rise on terminal groin and resultant impacts to inlet dynamics, adjacent property, beach profiles, residential structures, natural resources/environment of island, adjacent islands and estuarine habitats	NCCF	Sea Level Rise	Section 4.0 and Section 5.0; Scale of sea level rise not able to be accounted for in modeling
18	Include cost-benefit analysis associated with storms for each project alternative using real world property appraisals, including risk of storm damage to beach front properties	NCCF	Financial/Economic	Beyond Scope of EIS
19	Include cost-benefit analysis of positive economic values associated with natural inlet processes (fishing, tourism, habitat creation, larval transport and fish migration)	NCCF	Financial/Economic	Section 5.14
20	Study/model effects of terminal groin on inlet dynamics, including alteration of dredge frequency, structural integrity of groin, and impacts to shoreline east and west of terminal groin	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013)
21	Study/model effects of terminal groin on ebb shoal deflation and associated economic and resource related costs	NCCF	Physical/Economic	Olsen Associates Engineering Report (Olsen 2013), Economics of shoal deflation beyond scope of EIS
22	Study/model effects of terminal groin on federal navigation project (including impacts to terminal groin associated with future navigation channel maintenance events), include plan for monitoring these impacts	NCCF	Physical	Inlet Management Plan (Appendix B) and Olsen Associates Engineering Report (Olsen 2013)

Village of Bald Head Island Shoreline Protection Project - Scoping Comment Table

No.	Nature of Comment (Summary)	Agency/Entity	Category	Inclusion in DEIS
23	Assess impacts to longshore transport of sediment to West Beach and resultant erosion/accretion including impacts to natural resources and infrastructure from erosion/accretion	NCCF	Physical	Section 5.0 and Olsen Associates Engineering Report (Olsen 2013)
24	Study/model need for existing sand tube groin field in addition to construction of terminal groin, include effects of project without sand tube groin field	NCCF	Physical	Section 5.0 and Olsen Associates Engineering Report (Olsen 2013)
25	Assess effects of terminal groin on Oak Island (historic sites, public and private infrastructure)	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013)
26	Address impacts to piping plover habitat on both sides of inlet and compliance with Endangered Species Act	NCCF	Threatened and Endangered Species	Section 5.4 and Biological Assessment (to be submitted to USFWS)
27	Address impacts to Atlantic Sturgeon, Shortnose Sturgeon, Eastern Manatee and other endangered marine life in project area	NCCF	Threatened and Endangered Species	Section 5.4, Biological Assessment and Essential Fish Habitat (to be submitted to NMFS)
28	Address impacts to sea turtle habitat on Bald Head Island	NCCF	Sea Turtles	Section 5.4 and Biological Assessment
29	Address impacts to sea turtle habitat on Oak Island	NCCF	Sea Turtles	Section 5.0 addresses potential downdrift physical impacts. No impact to sea turtle nesting on Oak Island
30	Analysis of physical impacts of 'leaky' structure to sea turtles, critical marine and mammals	NCCF	Physical	Section 5.4, Biological Assessment and Essential Fish Habitat Report
31	Assess how adult and hatching turtles will survive storm and wave action in and around terminal groin	NCCF	Sea Turtles	Section 5.4 and Biological Assessment
32	Include 'leakage' rate of terminal groin, calculation of 'leakage' rate and milestones to address/monitor 'leakage' rate	NCCF	Physical	Section 3.0 and Engineering Report
33	Assess impacts of groin 'leakage' to beach nourishment, public beach, beach natural resources, erosion/accretion on West Beach	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013)

Village of Bald Head Island Shoreline Protection Project - Scoping Comment Table

No.	Nature of Comment (Summary)	Agency/Entity	Category	Inclusion in DEIS
34	Address potential blockage of 'leaky' groin (i.e. growth of marine life, debris, etc.) and strategies to address blockages	NCCF	Physical	Physical monitoring and maintenance as identified in Inlet Management Plan
35	Assess terminal groin impacts to Cape Fear River inlet system, tidal flow and fish migration, EFH and Jay Bird Shoals	NCCF	Physical	Section 5.5, Olsen Associates Engineering Report (Olsen 2013); Appendix M and Essential Fish Habitat Report
36	Provide proof and analysis that terminal groin will reduce beach nourishment	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013)
37	Assess effects of 'leaky' structure on frequency of beach nourishment	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013)
38	Study effects of terminal groin on inlet sediment balance and include resultant inlet/sediment management costs in project alternatives	NCCF	Physical	Olsen Associates Engineering Report (Olsen 2013) and Inlet Management Plan (Appendix B)
39	Include enhancement/revision of existing sand tube groin field as project alternative, including analysis of sand tube success on the Island	NCCF	Physical	Section 1.4 and 3.2
40	Is combination of both sand tube groin field permit plus TG permit a violation of SB 110? provide legal opinion from state and CRC	NCCF	SB 110 State Regulation	Not currently addressed
41	Determine if recruitment to adult fish stocks is limited by larval ingress to estuarine nursery habitats	NC DMF	Fisheries	Fish Larvae Response Model (Appendix M); EFH Report
42	Study effects of terminal groin on larval transport through altered beach and nearshore sediment profile	NC DMF	Fisheries	Fish Larvae Response Model (Appendix M); EFH Report
43	Provide detailed scientific field investigation, analysis and modeling of larval transport and distribution around Bald Head Island	NC DMF	Fisheries	Literature Review submitted under separate cover to NCDMF, Fish Larvae Response Model (Appendix M), and EFH Report

Village of Bald Head Island Shoreline Protection Project - Scoping Comment Table

No.	Nature of Comment (Summary)	Agency/Entity	Category	Inclusion in DEIS
44	Model estimated impacts of the groin to larval ingress and egress through inlet	NC DMF	Fisheries	Fish Larvae Response Model (Appendix M)
45	Provide field investigation of juvenile fishes in vicinity of the inlet and proposed groin location	NC DMF	Fisheries	Literature Review submitted under separate cover to NCDMF
46	Provide benthic macroinvertebrate monitoring within impact area of proposed groin	NC DMF	Fisheries	Literature Review, VBHI Monitoring Reports (2010 - 2013)
47	Provide discussion of all EFH and state protected habitats occurring in this area	NC DMF	Fisheries	Section 5.4, Essential Fish Habitat Report and Biological Assessment
48	Provide discussion of all fish habitats outline in NC CHPP occurring in this area	NC DMF	Fisheries	Essential Fish Habitat Report
49	Identify potential impacts to fish and invertebrate community composition and abundance in inlet and adjacent surf zone on BHI	NC DMF	Fisheries	Section 5.5 and Essential Fish Habitat Report
50	Provide literature review of research regarding larval transport through inlets, especially inlets with hardened structures and include in EIS	NC DMF	Fisheries	Literature Review submitted under separate cover to NCDMF
51	Identify potential impacts to benthos of the surf/swash zone and nearshore areas	NC DMF	Fisheries	Section 5.5 and Essential Fish Habitat Report
52	Provide detailed monitoring plan for impact assessment within project area	NC DMF	Fisheries	Appendix B – Inlet Management Plan (existing detailed survey monitoring program)
53	Identify potential impacts to commercial or recreational fishing	NC DMF	Fisheries	Section 5.9 and 5.11
54	Identify economic impacts due to adverse impacts to fish and fish habitat	NC DMF	Fisheries/Economic	Section 5.14
55	Identify impacts from dredging, beach placement and nearshore placement of sand and minimization efforts	NC DMF	Fisheries	Section 5.4; 5.5; 6.0; and pending BA and EFH Reports
56	Identify potential impacts to regional sand budgets	NC DMF	Fisheries	Olsen Associates Engineering Report (Olsen 2013)

Village of Bald Head Island Shoreline Protection Project - Scoping Comment Table

No.	Nature of Comment (Summary)	Agency/Entity	Category	Inclusion in DEIS
57	Clearly discern proposed timelines for beach nourishment and identify potential impacts to nesting sea turtles, West Indian manatee, seabeach amaranth and piping plover in project area	USFWS	Threatened and Endangered Species	Section 5.4 and Biological Assessment
58	Identify potential impacts to nesting sea turtles, West Indian manatee, seabeach amaranth and piping plover on Oak Island	USFWS	Threatened and Endangered Species	Beyond Scope of EIS
59	Assess impacts from sediment disposal from Wilmington Harbor SMP occurring on Oak Island within the same year	USFWS	Physical	Beyond Scope of EIS
60	Outline proposed construction logistics and timelines	USFWS	Physical	Section 3.2.5 and CAMA Major Application
61	Determine if available sources of sand are adequate to meet proposed method and schedule of construction	USFWS	Physical	Section 3.2.5
62	Examine long-term effects to sea turtles, West Indian manatee, seabeach amaranth and piping plover from proposed beach nourishment schedule (every 2 years)	USFWS	Threatened and Endangered Species	Cumulative Effects Analysis (Appendix Q)
63	Identify levels of erosion on Oak Island and West Beach from construction of terminal groin and resultant impacts to listed species	USFWS	Physical/Threatened and Endangered Species	Biological Assessment and Olsen Associates Engineering Report (Olsen 2013)
64	Include analysis of potential sea-level rise scenarios in Cumulative Impacts Analysis, including sea level rise impacts to structural integrity of terminal groin and nourishment schedule for life of the project	USFWS	Sea Level Rise	Section 5.0; Cumulative Effects Analysis (Appendix Q)
65	Assess sea level rise impacts to structural integrity of terminal groin and nourishment schedule for life of the project	USFWS	Sea Level Rise	Section 5.0
66	Provide underwater survey (conducted by experienced archaeologist) to identify presence of submerged archaeological remains in project boundaries, assess impacts of terminal groin construction on historical resources	SHPO	Cultural/Historical Resources	Archeological Report (Appendix H)
67	Provide 5 complete sets of the application and associated maps to DWQ Central Office in Raleigh	NC DWQ	Administrative	CAMA Major Application
68	Provide appropriate application fee	NC DWQ	Administrative	CAMA Major Application

Bald Head Terminal Groin &Beach Nourishment
Scoping Meeting March 22, 2012
ILA Hall @ 211 W 10th St, Southport

AGENDA

SIGN IN.	
Welcome Remarks	Dave Timpy, Corps of Engineers
Elected officials remarks.	Mayor Pro Tem John Smith
EIS Process	Dale Beter, Corps of Engineers
Project Overview	Erik Olsen, Olsen & Associates
Break out into group sessions.	Corps of Engineers & Olsen & Associates
Meeting was adjourned.	

Meeting Summary

The Bald Head Terminal Groin &Beach Nourishment scoping meeting was held on March 22, 2012 it the ILA Hall located in Southport, North Carolina. There were approximately 14 attendees with three citizens from Bald Head Island.

One group session was held. The comments obtained from this group were as follows:

1. Will the EIS address all the points in Senate Bill 110?
2. Does the Terminal Groin alleviate the need for the 16 sand filled groin tubes?
3. Will the EIS address changes of wave energy on the opposite side of the channel?
4. Will the EIS address how the groin will affect the navigation channel or vice versa?
5. How will the beach fill be affected by permeability of the groin?
6. Will the groin affect the need of beach sand on Bald Head Island?
7. How will the EIS address Sea Level Rise?

BALD HEAD ISLAND TERMINAL GROIN AND BEACH NOURISHMENT PROJECT - PUBLIC SCOPING MEETING
ILA HALL - SOUTHPORT (NC) - MARCH 22, 2012

SIGN-IN SHEET - GROUP 1

NAME	AFFILIATION	TELEPHONE OR EMAIL
1 Karen Ellison	Village of Bald Head Isle	Kellison@VillageBHI.org
2 JOE BRAWNER	BHI	BRAWNERPLAND@msn.COM
3 CHRIS MCCALL	VBHI	cmccall@villagebhi.org
4 Layton [illegible]	DC&A	[illegible]@dialcordy.com
5 Steve Dial	DC&A	sdial@dialcordy.com
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BALD HEAD ISLAND TERMINAL GROIN AND BEACH NOURISHMENT PROJECT - PUBLIC SCOPING MEETING
ILA HALL - SOUTHPORT (NC) - MARCH 22, 2012

SIGN-IN SHEET - GROUP 2

	NAME	AFFILIATION	TELEPHONE OR EMAIL
1	John Fisher	Village of BHI	Fisher5@att.net
2	Calvin Peck	Village BHI	cpeck@villagebhi.org
3	Ben Brown	State Port Pilot	bbrown@stateportpilot.com
4	Harry Simmons	Caswell Beach	mayor@caswellbeach.org
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BALD HEAD ISLAND TERMINAL GROIN AND BEACH NOURISHMENT PROJECT - PUBLIC SCOPING MEETING
ILA HALL - SOUTHPORT (NC) - MARCH 22, 2012

SIGN-IN SHEET - GROUP 3

	NAME	AFFILIATION	TELEPHONE OR EMAIL
1	Mike Giles	NC Coastal Federation	mikeg@nccoast.org
2	Ray Webb	Bald Head Island	~~4[illegible]~~ webb8636@BellSouth.NET
3	Michael Rice	Save the Cape	mike@savethecape.org
4	Bob Helgesen	Village of Bald Head	Khelgesen@ME.com
5	Jonathan Howell	DCM	252-808-2808
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Village of Bald Head Island Shore Protection Project
PDT Meeting #1

April 24, 2012
2:00 PM @ DENR Wilmington Office

Meeting Minutes

Cameron Weaver (DENR) initiated the meeting and asked attendants to introduce themselves and identify their respective affiliation. The following individuals were in attendance: Cameron Weaver (NCDENR-DEAO), Ron Sechler (NOAA-NMF) via conference call, John Ellis (USFWS) via conference call, Kathryn Matthews (USFWS) via conference call, Jessi Baker (DMF) via conference call, Doug Huggett (DCM), Debbie Wilson (DCM), Heather Coats (DCM), Jonathan Howell (DCM), Chad Coburn (DWQ), Molly Ellwood (WRC), Dave Timpy (USACE), Justin McCorkle (USACE), Todd Horton (USACE), Spencer Rogers (NC Sea Grant), Christian Preziosi (LMG), Jenny Johnson (LMG), Laura Stasavich (LMG), Erik Olsen (Olsen Associates, Inc), Andy Sayre (VBHI), Calvin Peck (VBHI), Chris McCall (VBHI), Charles Baldwin (Rountree, Losee &Baldwin, LLP), Suzanne Dorsey (BHI Conservancy), Dara Royal (Town of Oak Island) and Harry Simmons (Town of Caswell Beach).

Corps Presentation - Dave Timpy provided the PDT members with a summary of the PDT protocol including the primary roles of the Corps and the PDT members. Dave reiterated that the Corps will make the ultimate decisions with consideration to PDT input, and future permit decisions will be made through the individual permitting agencies (i.e. Corps, DCM and DWQ). Dave also indicated that the Corps permit decision will only be made after permit decisions are made by DCM and DWQ. The following specific roles of the Corps and PDT members were further discussed:

1. The Corps will establish a study schedule based on input from the applicant and PDT. This schedule will establish future dates of PDT meetings. These dates may be revised as needed. *Project Update: A DRAFT Study schedule has been prepared by LMG and the Corps and will be refined after today's meeting.*

2. The Corps will post all environmental documents and current study schedule on the Corps website at:

http://www.saw.usace.army.mil/Wetlands/Projects/BaldHead_Terminal_Groin/index.html

3. In coordination with the NCDCM, the Corps will coordinate the time and place of all PDT meetings. The Corps will provide as much advance notice to the PDT as possible. The Corps of Engineers will moderate all PDT meetings.

4. The Corps will provide meeting agendas for each PDT meeting to ensure discussions are focused on selected topics. Extended discussions on singular topics may be limited by the Corps to a reasonable time frame.

5. PDT members will be provided information regarding the ongoing study and will be solicited for input on the study. At no time will the PDT be asked to vote on any item related to the Corps permit decision. In addition, PDT members are not to construe participation on the PDT as a way to "vote" on certain aspects of the project.

6. The Corps will document all PDT meetings. Meeting summaries will be provided to the PDT members. These summaries will likely be included in the EIS for this project.

7. Notification of PDT meetings will be sent to the PDT prior to each meeting. Due to the large number of PDT members on this project, it may be necessary to hold some meetings without full attendance by all members of the PDT. Meetings held prior to the scheduled PDT meetings by PDT members are not encouraged. Any such meetings shall be brought to the attention of the Corps and documented.

8. PDT members can at any time provide input and/or suggestions regarding the proposed project or PDT process to the Corps for consideration. PDT members can at any time submit a request for a PDT meeting to the Corps. The Corps, in coordination with the NCDCM, will decide if the requested PDT meeting is warranted.

9. The Corps, in close coordination with the NCDCM, will make final decisions regarding the project purpose and need, alternatives to be carried forward, the least environmentally damaging practicable alternative, and mitigation requirements associated with the proposed project.

10. The Corp's permit decision will only be made after permit decisions are made by the NC Division of Water Quality (i.e. 401 Water Quality Certification) and the NCDCM (CAMA Major Permit) for this project.

Doug Huggett asked if the study schedule has been sent to the PDT. Christian Preziosi indicated that the DRAFT has been sent to the PDT. Dave Timpy indicated that he will resend the DRAFT study schedule following the meeting. Doug also suggested that given the complexity of the process, future meetings be allotted more time for discussion. Dave indicated that PDT meeting minutes will be included in the EIS.

Olsen Associates, Inc Presentation - Erik Olsen from Olsen Associates, Inc. (project engineer for the Applicant) provided the group with a history of the bathymetry and hydrodynamics of the area prior to the construction of the federal navigation channel to present day conditions. Erik gave an overview of the draft proposed action (terminal groin) and provided the group with examples of similar structures that Olsen Associates, Inc. have successfully implemented in the southeast (including Hilton Head and Amelia Island). Erik also discussed the 'leaky' nature of the structure to allow for some level of sediment transport around the Point to West Beach. Jay Bird Shoals (JBS) was identified as an alternate sand source for the groin fillet. (JBS is a previously authorized borrow site with sufficient volume of beach quality sand remaining within the permitted limits of the borrow site.) Erik indicated that there is an existing inlet management plan by way of the Federal Sand Management Plan (SMP).

Justin McCorkle reminded members of the PDT that Erik's presentation is an analysis of the project as presented by Olsen Associates/VBHI. VBHI and Corps are presently engaged in a lawsuit and some of the information presented during the meeting is in the midst of litigation to which a resolution has yet to be determined. Justin indicated that the overall consensus is to reduce erosion for the VBHI. The Corps EIS document will try to contain facts independent of the issues presently in litigation.

<u>LMG, Inc Presentation</u> - Christian Preziosi provided a summary of the status of the project and the EIS process to date:

Jan 2012 – EIS process initiated
March 14, 2012 – Notice of Intent
March 14, 2012 – Public Notice
March 22, 2012 – Public Scoping Meeting, Southport, NC
March 28, 2012 – Interagency Meeting

Christian indicated that there are 3 PDT meetings planned, however, this may be subject to change. Christian indicated that currently the Corps and LMG (as the third-party contractor) are in the information gathering stage of the EIS. Christian provided a general description of the different sources of information to be used and a summary of the literature review by resource. He discussed the need to identify the study area by resource type and requested input from the PDT regarding any potential data/information needs.

Christian provided a brief description of the elements of the draft EIS – including the Purpose and Need and Alternatives advanced by the Applicant. He stated that the EIS will consider a full range of reasonable alternatives to address the purpose and need of the project. The actual alternatives to be included in the Draft EIS will be determined by the Corps with the input of the PDT. Christian described that the EIS will also include a description of the existing environment, potential effects of the alternatives on the existing environment, a Cumulative Effects Analysis (CEA), an Essential Fish Habitat (EFH) report, and a Biological Assessment (BA). Christian also provided a summary of the remaining tasks in the project processing (i.e. submittal of Final EIS, CAMA Major application, DA Permit application and the Record of Decision).

Doug Huggett reminded the PDT that the EIS process will result in a NEPA document; however a document compliant with SEPA must still be submitted to DCM for Clearinghouse review and public review/comment (45 day process depending on when notice is given in the Environmental Bulletin). Justin McCorkle suggested submitting SEPA document in conjunction with CAMA Major Permit application. Doug indicated that the Clearinghouse review will have to be completed before the CAMA Major application can be accepted as complete. Justin indicated that he would hope that the State Clearinghouse review period could align with the public review period for the EIS (NEPA process).

Dave Timpy asked for comments from NOAA-NMFS and USFWS concerning submittal of BA and EFH documents and formalized Section 7 consultation. Kathryn Matthews will consult will John Ellis and get back to Dave or Christian. Ron Sechler indicated that Atlantic Sturgeon has been recently listed and Fritz Rhode will be the point of contact concerning this species.

Calvin Peck indicated a concern for getting more agency comments circulating during present and future PDT meetings. Christian stated that the Corps will need feedback from the PDT for potential alternatives at the next PDT meeting. Justin indicated that this is a 'phased' process. Phase I is to get all relevant issues on the table while Phase II will be a response to data gathered. Justin suggested that we are still in Phase I and comments will be collected during PDT meetings and submittal of a DRAFT EIS.

Doug discussed the alternatives analysis as seen through NC Senate Bill 110 and suggested that mitigation costs and requirements, including project failure/removal of structure will need to be included in the alternatives analysis. Spencer Rogers asked if project removal will need to be included in the alternatives analysis. Doug Indicated yes, as project bonding, mitigation, etc. will need to be addressed, and the legislation requires the terminal groin alternative to include full failure in the EIS and CAMA Major Permit application. Charles Baldwin suggested that the Delft 3D model will give good insight to the potential level of failure, short of complete failure. Doug Huggett indicated that a financial threshold will need to be set so the cost is not open-ended if removal is required. Also, discovery of mitigative measures need to be identified on the front end of the project rather than the back end.

Christian asked if the legislation states that failure/removal must be included in the Alternatives Analysis section of the document or if it could be addressed elsewhere in the EIS. Doug suggested that detailed discussion of all alternatives need to be in the Alternatives Analysis section of the EIS, including project failure.

Justin indicated that this level of analysis is not required as part of NEPA; however, the document will need to meet all agency requirements, including DCM. Harry Simmons questioned the need to determine failure costs for all alternatives. Doug answered yes.

Doug further discussed portions of NC Senate Bill 110 including inlet management plan, post-construction activities, baseline for adverse impacts, threshold for mitigation including groin removal and establishment of error bars, etc. Spencer Rogers indicated that the Delft 3D model will be an advantage. Doug reminded PDT that if a data set already exists to use it.

Christian asked about the Regulatory Reform Act and how it affects the SEPA requirement of SB 110. Doug indicated that SB 110 requires SEPA since it is an individual item in a separate law. Spencer Rogers asked if this was a jetty project, would the SEPA process be triggered. Doug indicated that he believes there would be no SEPA process for a jetty project.

Jessi Baker indicated that she had submitted comments on behalf of DMF to the Corps and that the effects to larval transport will be especially important. Ron Sechler shares same concerns as DMF and will also submit a letter with comments/concerns to Corps.

Kathryn Matthews will discuss project with John Ellis and send a letter with comments/concerns on behalf of USFWS. Initial concerns include sea turtles and plover, but not necessarily seabeach amaranth.

Chad Coburn had no formal comments at this time. Dara Royal had no official comment at this time.

Dave Timpy indicated that he will send the meeting minutes and DRAFT project schedule to the PDT. The next meeting will help establish a definitive 'purpose and need' and the alternatives that will be carried forward in the Draft EIS.

The meeting was adjourned as approximately 4:00.

Village of Bald Head Island Shore Protection Project
PRT Meeting #2

September 12, 2012
10:00 AM @ DENR Wilmington Office

Meeting Minutes

Cameron Weaver (DENR) initiated the meeting and asked attendants to introduce themselves and identify their respective affiliation. The following individuals were in attendance: Cameron Weaver (NCDENR-DEAO), Kathryn Matthews (USFWS) via conference call, Jessi Baker (DMF), Fritz Rohde (NOAA-NMF), Doug Huggett (DCM), Debbie Wilson (DCM), Heather Coats (DCM), Jonathan Howell (DCM), Chad Coburn (DWQ), Jim Gregson (DWQ), Dave Timpy (USACE), Justin McCorkle (USACE), Bill Dennis (USACE), Dale Beter (USACE), Emily Hughes (USACE), Thekla Spencer (USACE), Spencer Rogers (NC Sea Grant), Christian Preziosi (LMG), Jenny Johnson (LMG), Erik Olsen (Olsen Associates, Inc), Calvin Peck (VBHI), Charles Baldwin (Rountree, Losee & Baldwin, LLP), Suzanne Dorsey (BHI Conservancy), Harry Simmons (Town of Caswell Beach), Peter Schuhmann (UNCW), Mike Giles (NCCF) and Anazivanovic Nenadovic (NCCF).

Dave Timpy provided a brief introduction before handing the meeting over to Land Management Group, Inc (LMG). Christian Preziosi stated the purpose and objectives of the meeting and encouraged attendees to feel free to have an open discussion on any items discussed during the meeting. The following Items highlight the meeting objectives and resultant PRT discussion.

1.0 Meeting Objectives
No comments.

2.0 Actions Completed Since PRT Meeting No. 1
No comments.

3.0 Purpose and Need Statement
Suzanne Dorsey suggests that the proposed terminal groin is an engineered response to an already engineered (non-natural) shoreline adjacent to a federal navigation channel which is important from a resource perspective.

Erik Olsen stated that there is already a structural component to reduce erosion on South Beach (existing sand tube groinfield). The proposed terminal groin will take the project to the next tier of structural stabilization. Existing groinfield has not been sufficient to solve current shoreline recession.

4.0 Range of Alternatives under Consideration

4.1 No Action Alternative
E. Olsen discussed that under this alternative the groinfield would not be removed and ultimately will be allowed to degrade (until required to remove due to degradation). This alternative would lead to ineffective nourishment efforts during federal channel maintenance/sand placement events and thus Corps would likely move sand placement further East away from the channel which would be detrimental to needs of VBHI.

H. Simmons asked if this alternative assumes current SMP will remain (ie. sand placement every 4 years).

D. Huggett indicated that the No-Action alternative should include additional components including a Status Quo option in which the Village would maintain the existing sand tube groinfield as well as providing for periodic nourishment.

C. Preziosi concurred with the Status Quo component of groinfield maintenance, but stated that additional nourishment events are best evaluated under separate alternative (as has been identified). J. McCorcle agreed that any additional nourishment action would be another alternative. J. McCorcle went on to state that federal disposal events under current SMP can be considered under the Village's No-Action Alternative.

S. Dorsey indicated that VBHI citizens would prefer not having the need of the sand tube groinfield for several reasons including expense and aesthetics. H. Simmons asked about sea turtle nesting in existing groinfield. S. Dorsey indicated that groinfield is not ideal habitat but better than no sand.

4.2 Retreat

S. Dorsey asked the PRT to recognize how hard this alternative would be for the citizens of VBHI, especially given the sensitive and sustainable land plan the Island has adopted.

D. Huggett indicated that this alternative is critical for satisfying SB 110 since it is a non-structural alternative. PRT members asked about public vs. private nature of golf course. C. Preziosi indicated that the lagoons are an integral aspect of stormwater management on the Island. C. Peck indicated that VBHI is not economically stable without golf course.

Several PRT members suggested adding business (particularly with respect to the BHI Club) to the Purpose and Need Statement.

S. Rogers stated that relocation was implemented in the past but given the extent of private and public infrastructure present today, this alternative is not practical.

E. Olsen also suggested the consideration of the effect of retreat on historic structures in the vicinity of the project. Village to provide information on historic structures.

4.3 Beach Nourishment/Beach Disposal w/ Existing Sand Tube Groinfield

D. Huggett indicated that this was the second half of the No-Action alternative that he suggested earlier in the meeting. E. Olsen indicated that it was considered a separate alternative because it is so proactive. C. Peck asked where/when the costs for Wilmington Harbor Entrance Channel will be discussed.

D. Huggett indicated that DCM will require an alternatives analysis for a permit decision and understood that the actual alternatives analysis is not performed in the DEIS but later in the NEPA process. The Village has identified a proposed action (terminal groin with sand tube groinfield remaining), but J. McCorcle stated that the Corps will not endorse or prefer any alternative during the EIS process. The Corps makes its determination on a permit through the 404(b)(1)/public interest review analysis (done in the ROD).

The PRT had a general conversation concerning the economic costs for the range of alternatives proposed for the DEIS. The Corps and DCM explained that a full range of analysis is required as part of the process and ultimately this information will be used to determine which alternatives may or may not be practicable.

S. Dorsey and C. Peck expressed concerns for the potential costs of some of the alternatives included in the document. The Corps indicated that costs considerations will be factored into the analysis, and that the Village can provide any supporting information they feel necessary to assist with the Corps' analysis. D. Huggett indicated that there may be items needed within DCM's permit application as a result of SB110 which might not necessarily be included for the Corps' ROD.

E. Olsen provided information on how he is initially evaluating costs – including the use of a long-term interest rate used by the Corps. D. Huggett indicated that there was no specific guidance in SB110 regarding the duration of the assessment, but stated that a 30-year analysis would be sufficient.

4.4 Beach Nourishment/Beach Disposal and Sand Tube Groinfield Removal

No Comments.

4.5 Terminal Groin with Beach Nourishment/Beach Disposal (Sand Tube Groinfield Remaining)

C. Preziosi discussed the range of proposed designs for the terminal groin and clarified that all options in this alternative would be considered in the Environmental Consequences Section of the EIS. This alternative represents the Village's proposed action.

D. Huggett asked if this alternative addresses future nourishment events.

The PRT discussed that this alternative assumes continuation of the SMP. Part of the analysis to be included in the document will discuss the frequency of nourishment events subsequent to project completion. E. Olsen indicated that the frequency of nourishment may not change; however, the volume of sand lost will be reduced once a stable beach condition is obtained. This will be a net benefit to the federal project but it will be hard to determine where the sand will end up upon construction of a terminal groin.

D. Huggett indicated that SB110 requires a plan for the fillet but does not mandate periodic sand placement. However, the required inlet management plan will likely include items such as maintenance of the fillet, etc. The plan would need to acknowledge contingencies for additional nourishment. Separate sand sources and mitigative thresholds would need to be identified in the permit application, and future nourishment may be authorized via permit modification prior to sand placement.

J. McCorcle suggested that the EIS could be used for a decision document on a 30-year permit if it incorporated sufficient information.

C. Peck expressed concern that the cost for analyzing separate sand sources is expensive. The Corps and DCM suggested analyzing sources that have been used in the past (ie. Jay Bird Shoals, Bald Head Shoal, Wilmington Harbor Entrance Channel). While permitting agencies made no commitment to authorizing the use of these areas for future sand source sites, it was agreed that new information on other sites may not be warranted since there are existing sites that have been thoroughly analyzed in other documents.

The PRT discussed the logistics of utilizing the existing Wilmington Harbor Entrance Channel. D. Timpy indicated that as long the request was within the confines of the approved project, a General Permit could be issued through Corps.

D. Huggett suggested including source sites for contingency nourishment so that it could be factored into DCM's permit decision.

4.6 Terminal Groin with Beach Nourishment/Beach Disposal and Removal of Sand Tube Groinfield

C. Peck asked if there was an 'intermediate' between Alternative #5 and #6 that would evaluate the redesign of the existing groinfield (i.e. converting the existing sand tubes to a rock groinfield). S. Rogers indicated that this was against State law.

E. Olsen indicated that he likely could not design a terminal groin long enough to justify complete removal of the sand tube groinfield; however, it is likely that some tubes could be removed. Physical monitoring would provide information necessary to determine need for maintenance or modification to groinfield.

4.7 Terminal Groin without Beach Nourishment

The PRT discussed if this alternative needed to be discussed further in the DEIS since it is a violation of SB110. The Corps indicated that the document would need to include the engineering rational of why this alternative may not be practicable. This alternative would be identified in the DEIS, but may be eliminated without a discussion of its consequences on the affected environment.

5.0 Study Areas

C. Preziosi provided a visual of the respective study areas (physical, biological, etc.). H. Simmons concurred that the study area was sufficient to address the concerns of Caswell Beach. S. Rogers suggested that the study area include the inlet hazard areas.

F. Rohde reminded LMG to make sure that the study area include Bald Head Creek Shoal area for any alternative that included that area as potential sand source.

6.0 Scoping Comments

C. Preziosi discussed the generalized scoping comments received to date. M. Giles asked if the comments could be distributed. The Corps will update their website for the project and will likely include scoping comments.

7.0 Next Steps

C. Baldwin and C. Peck asked about the timeline for submission of the DEIS and permit application. It was determined that permit applications will likely be submitted upon release of the Final EIS. The PRT discussed the timing for the next PRT meeting. The Corps will make a decision as to when the next PRT will be held.

LMG or Corps will supply copies of the meeting minutes and the Powerpoint Presentation to the PRT following the meeting.

Village of Bald Head Island Shoreline Protection Project

Interagency Scoping Meeting - March 28, 2012
2:00 PM @ DENR Wilmington Office

Meeting Notes

Cameron Weaver (DENR) initiated the meeting and asked attendants to introduce themselves and identify their respective affiliation. The following individuals were in attendance: Cameron Weaver (NCDENR-DEAO), Jessi Baker (DMF), Doug Huggett (DCM), Debbie Wilson (DCM), Heather Coats (DCM), Jonathan Howell (DCM), Shaun Simpson (DCM), Chad Coburn (DWQ), Molly Ellwood (WRC), David Cox (WRC), Jim Gregson (DWQ), Dave Timpy (USACE), Dale Beter (USACE), Christian Preziosi (LMG), Jenny Johnson (LMG), Erik Olsen (Olsen Associates, Inc), Calvin Peck (VBHI), Chris McCall (VBHI), Mike Giles (NCCF), Dawn York (Dial-Cordy) and Layton Bedsole (Dial-Cordy). NMFS and FWS did not participate in the meeting.

Cameron Weaver introduced Christian Preziosi from Land Management Group, Inc., the 3rd party contractor responsible for preparing the EIS and supporting documentation.

Christian Preziosi provided a brief status/schedule of the Public Notice for the EIS.

Doug Huggett followed with a discussion of NC Senate Bill 110. Mr. Huggett provided all attendants with a copy of the Senate Bill and provided the group with a overview of the legislation, specifically Section 1.(e)(5) discussing the inlet management plan. Chris McCall (VBH) asked about the science panel's framework/thresholds for monitoring. Mr. Huggett indicated that this information was available for review upon request.

Erik Olsen from Olsen Associates, Inc, (project engineer for the Applicant) provided the group with a history of the bathymetry and hydrodynamics of the area prior to the construction of the federal navigation channel to present day conditions. Erik gave an overview of the draft proposed project (terminal groin) and provided the group with examples of similar structures that Olsen Associates, Inc. have successfully implemented in the southeast (including Hilton Head and Amelia Island). Erik also discussed the 'leaky' nature of the structure to allow for some level of sediment transport around the Point to West Beach. Jay Bird Shoals (JBS) was identified as an alternate sand source for the groin fillet. (JBS is a previously authorized borrow site with sufficient volume of beach quality sand remaining within the permitted limits of the borrow site.) Erik indicated that there is an existing inlet management plan by way of the Federal Sand Management Plan (SMP).

Mr. Huggett gave agencies the opportunity to voice environmental concerns after the presentation was complete.

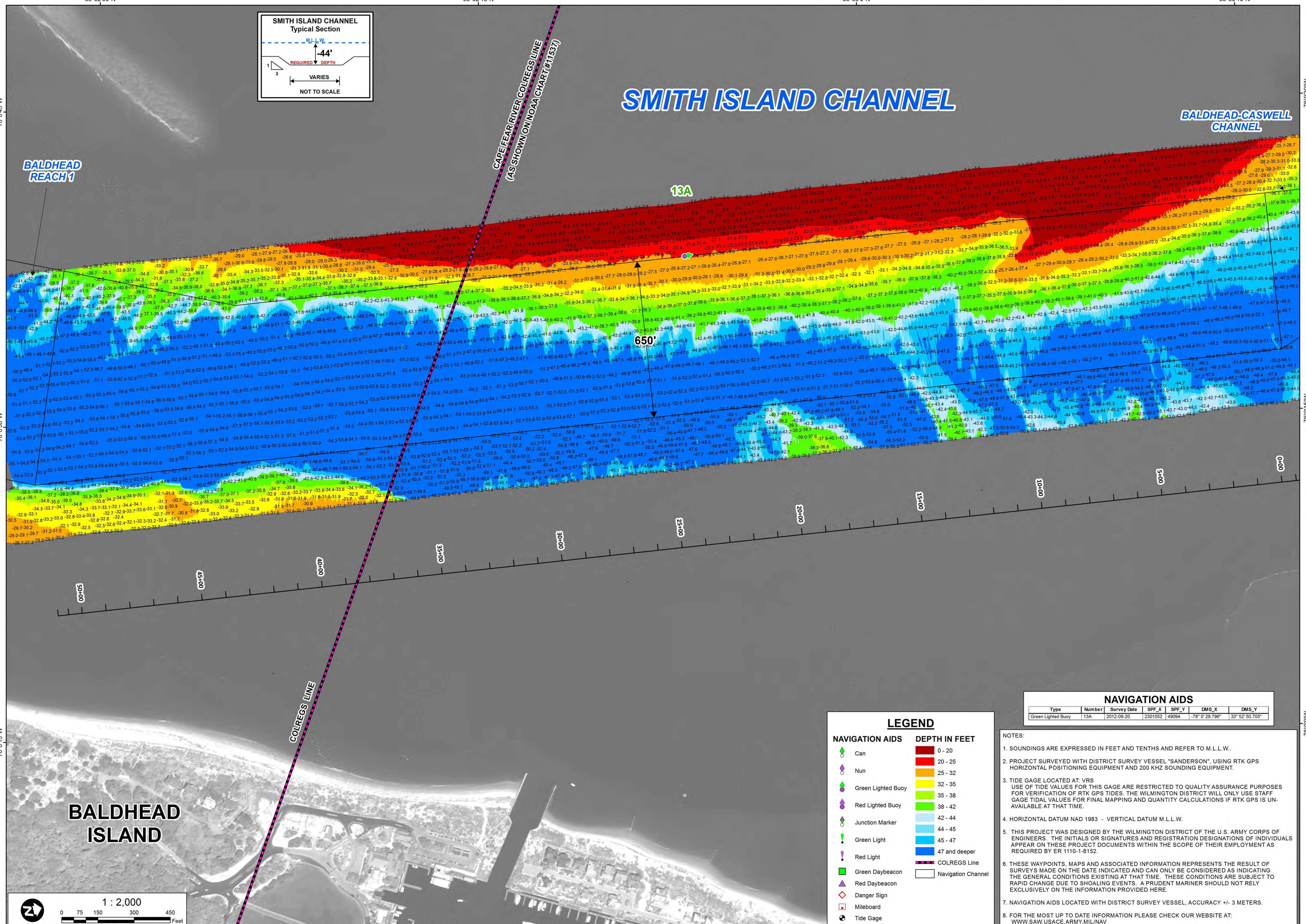
- DWQ – no comment at this time
- WRC – Ramifications of working in the moratorium
  - What is the frequency of nourishment on West Beach and South Beach?
  - How will the proposed project affect nourishment frequency on West Beach? (Will there be more erosion on West Beach?)
  - What will be the frequency and volume needs on West Beach post-construction?
- DCM – Response measures will need to be included in the EIS (*i.e.* account for cause and effect of proposed structure)

- DMF – Concerned about effect of TG on larval transport (i.e. longshore transport and daily migrations through water column)
    - Possibly include additional fish trawls/sampling as baseline
    - Is there a method to identify/model the effect on larval transport?
    - Juvenile/larval data, possibly using existing database but may need additional sampling
    - Benthic sampling and monitoring may be required
- USACE – Dale Beter reiterated that all resource issues will be evaluated through the EIS process. Dave Timpy identified need to finalize Project Delivery Team (PDT). A request for participation on PDT will be sent Week of April 2. USACE is tentatively planning for first PDT in late April.

Mr. Huggett adjourned the meeting at approximately 4:15 pm

APPENDIX D

USACE HYDROGRAPHIC SURVEYS



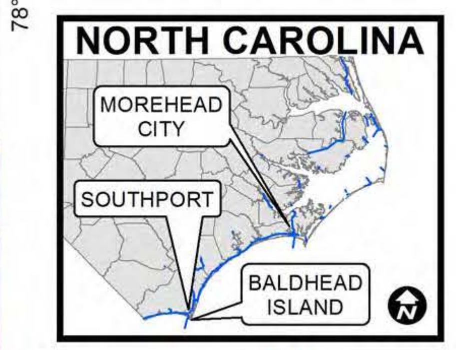
NAVIGATION AIDS

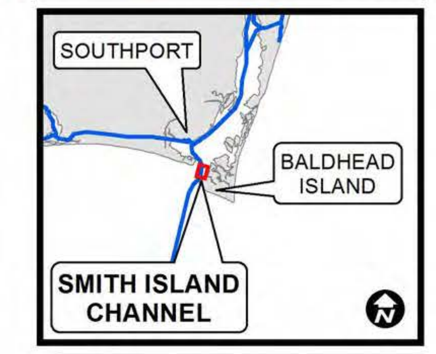
Type	Number	Survey Date	SPF_X	SPF_Y	DMS_X	DMS_Y
Green Lighted Buoy	13A	2012-09-20	2301052	49094	-78° 0' 29.796"	33° 52' 50.705"

NOTES:

1. SOUNDINGS ARE EXPRESSED IN FEET AND TENTHS AND REFER TO M.L.L.W..
2. PROJECT SURVEYED WITH DISTRICT SURVEY VESSEL "SANDERSON", USING RTK GPS HORIZONTAL POSITIONING EQUIPMENT AND 200 KHZ SOUNDING EQUIPMENT.
3. TIDE GAGE LOCATED AT: VRS
   USE OF TIDE VALUES FOR THIS GAGE ARE RESTRICTED TO QUALITY ASSURANCE PURPOSES FOR VERIFICATION OF RTK GPS TIDES. THE WILMINGTON DISTRICT WILL ONLY USE STAFF GAGE TIDAL VALUES FOR FINAL MAPPING AND QUANTITY CALCULATIONS IF RTK GPS IS UN-AVAILABLE AT THAT TIME.
4. HORIZONTAL DATUM NAD 1983 - VERTICAL DATUM M.L.L.W.
5. THIS PROJECT WAS DESIGNED BY THE WILMINGTON DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS. THE INITIALS OR SIGNATURES AND REGISTRATION DESIGNATIONS OF INDIVIDUALS APPEAR ON THESE PROJECT DOCUMENTS WITHIN THE SCOPE OF THEIR EMPLOYMENT AS REQUIRED BY ER 1110-1-8152.
6. THESE WAYPOINTS, MAPS AND ASSOCIATED INFORMATION REPRESENTS THE RESULT OF SURVEYS MADE ON THE DATE INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME. THESE CONDITIONS ARE SUBJECT TO RAPID CHANGE DUE TO SHOALING EVENTS. A PRUDENT MARINER SHOULD NOT RELY EXCLUSIVELY ON THE INFORMATION PROVIDED HERE.
7. NAVIGATION AIDS LOCATED WITH DISTRICT SURVEY VESSEL, ACCURACY +/- 3 METERS.
8. FOR THE MOST UP TO DATE INFORMATION PLEASE CHECK OUR WEBSITE AT: WWW.SAW.USACE.ARMY.MIL/NAV

US Army Corps of Engineers
Wilmington District





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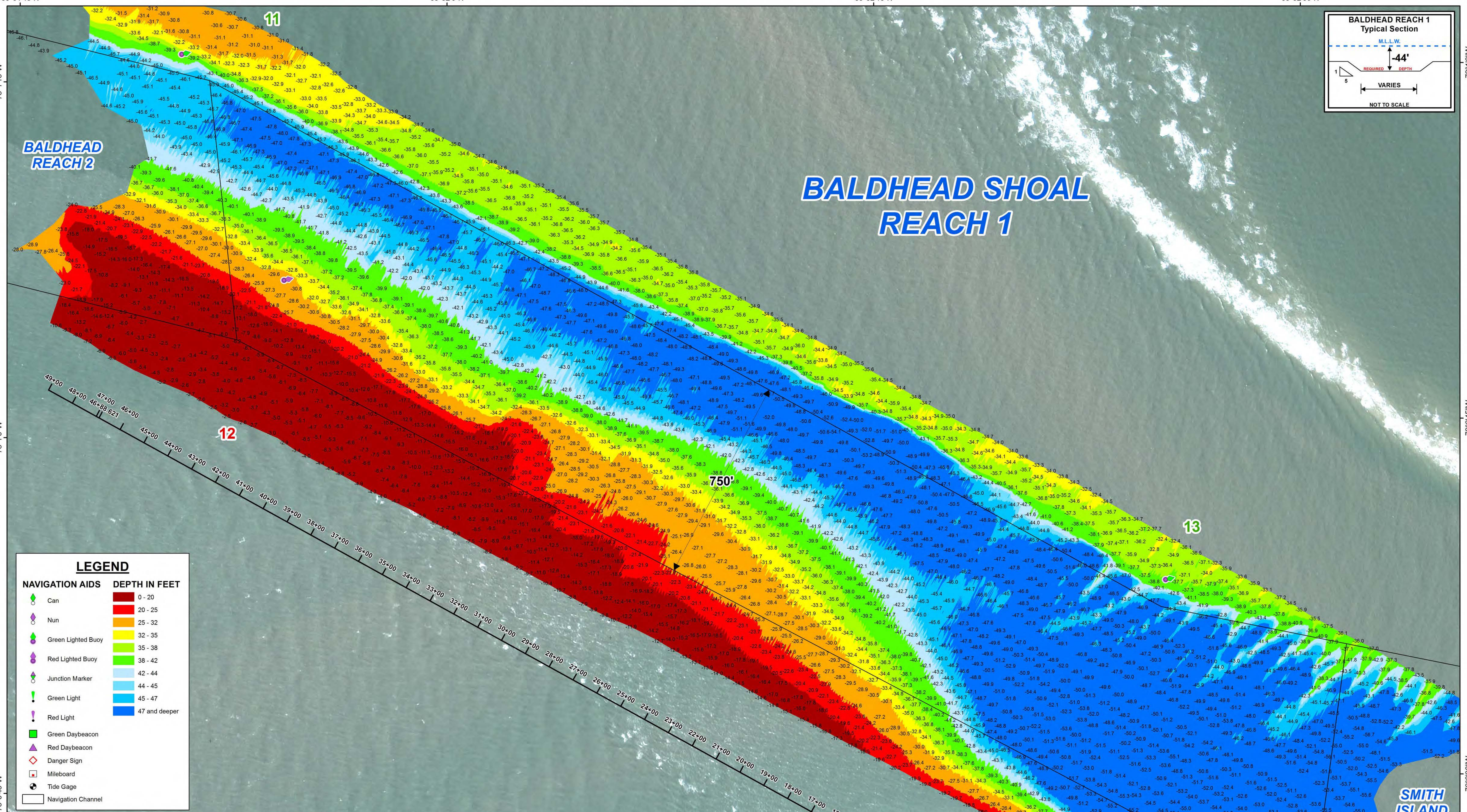
MAP DATE: SEPTEMBER 24, 2012 | MAPPED BY: MSA
MAP SCALE: 1 : 2,000 | MAP FILE # WH 105-12-90
IMAGERY DATE: MAY 8, 2012 © 2012 DIGITALGLOBE INC. | MAP FILE NAME: WILHBR-SMITH-ISLAND_2012-09-20_CS.MXD

CONDITION SURVEY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WILMINGTON, NORTH CAROLINA

WILMINGTON HARBOR SMITH ISLAND CHANNEL

WILMINGTON, NORTH CAROLINA



NOTES:

1. SOUNDINGS ARE EXPRESSED IN FEET AND TENTHS AND REFER TO M.L.L.W..

2. PROJECT SURVEYED WITH DISTRICT SURVEY VESSEL "SWART", USING RTK GPS HORIZONTAL POSITIONING EQUIPMENT AND 200 KHZ SOUNDING EQUIPMENT.

3. TIDE GAGE LOCATED AT: SOUTHPORT CITY PIER
USE OF TIDE VALUES FOR THIS GAGE ARE RESTRICTED TO QUALITY ASSURANCE PURPOSES FOR VERIFICATION OF RTK GPS TIDES. THE WILMINGTON DISTRICT WILL ONLY USE STAFF GAGE TIDAL VALUES FOR FINAL MAPPING AND QUANTITY CALCULATIONS IF RTK GPS IS UNAVAILABLE AT THAT TIME.

4. HORIZONTAL DATUM NAD 1983 - VERTICAL DATUM M.L.L.W.

5. THIS PROJECT WAS DESIGNED BY THE WILMINGTON DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS. THE INITIALS OR SIGNATURES AND REGISTRATION DESIGNATIONS OF INDIVIDUALS APPEAR ON THESE PROJECT DOCUMENTS WITHIN THE SCOPE OF THEIR EMPLOYMENT AS REQUIRED BY ER 1110-1-8152.

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7. NAVIGATION AIDS LOCATED WITH DISTRICT SURVEY VESSEL, ACCURACY +/- 3 METERS.

8. FOR THE MOST UP TO DATE INFORMATION PLEASE CHECK OUR WEBSITE AT: WWW.SAW.USACE.ARMY.MIL

NAVIGATION AIDS

Type	Number	Survey Date	SPF_X	SPF_Y	DMS_X	DMS_Y
Green Lighted Buoy	11	2013-02-07	2297363	42953	78° 1' 14.259" W	33° 51' 50.333" N
Red Lighted Buoy	12	2013-02-07	2298259	43118	78° 1' 3.618" W	33° 51' 51.879" N
Green Lighted Buoy	13	2013-02-07	2300104	45995	78° 0' 41.400" W	33° 52' 20.146" N

US Army Corps of Engineers
Wilmington District

NORTH CAROLINA

SOUTHPORT
BALDHEAD ISLAND
BALDHEAD SHOAL REACH 1

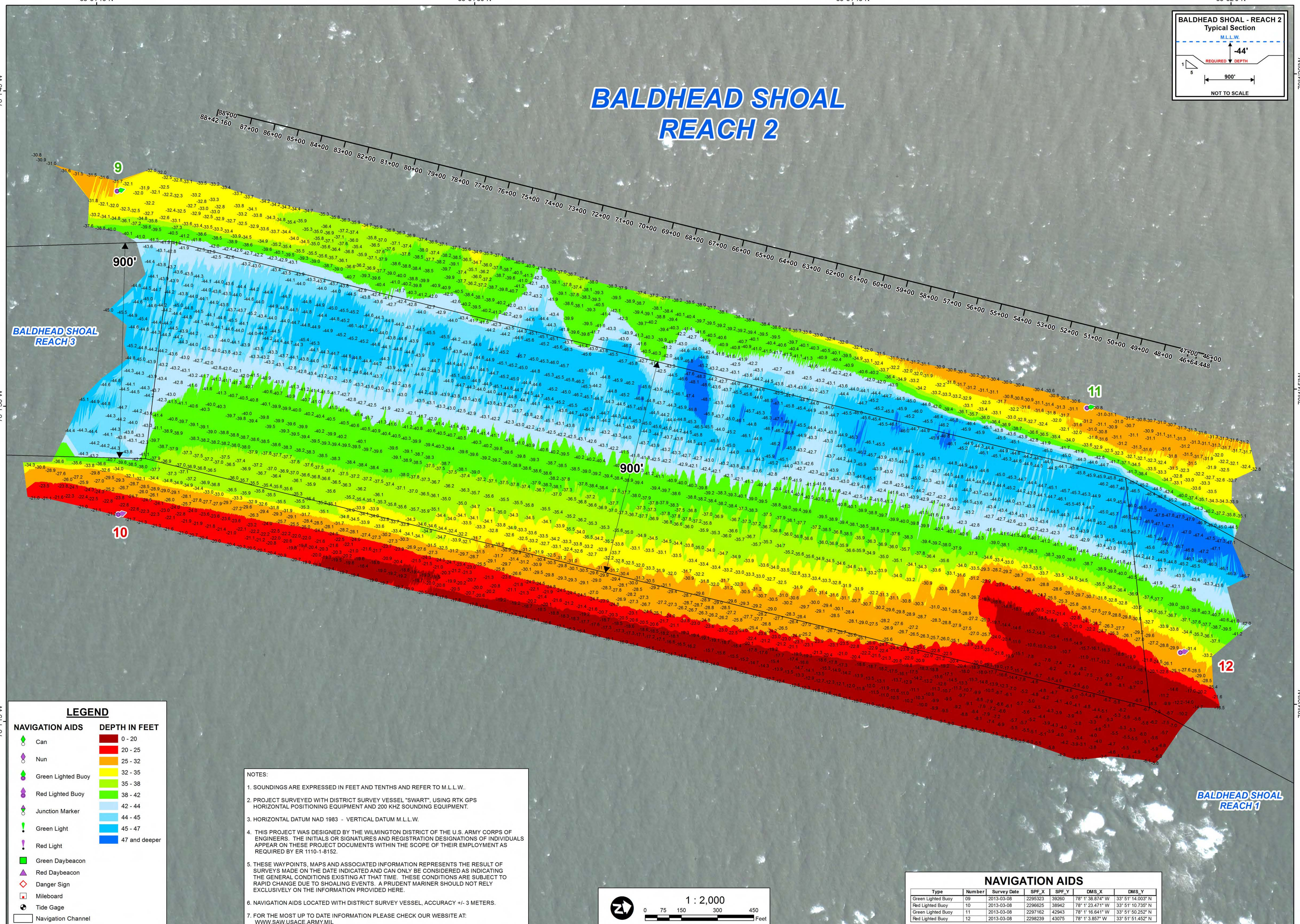
SURVEY DATE: FEBRUARY 6-7, 2013
SURVEYED BY: MAS, WWW
MAP DATE: FRBRUARY 11, 2013
MAPPED BY: MSA
MAP SCALE: 1 : 2,000
IMAGERY DATE: DECEMBER 19, 2012 © 2012 DIGITALGLOBE INC.
MAP FILE NAME: BALDHEADSHOAL1_2013-02-07_CS.MXD

BEFORE DREDGE SURVEY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WILMINGTON, NORTH CAROLINA

WILMINGTON HARBOR
BALDHEAD SHOAL - REACH 1

WILMINGTON, NORTH CAROLINA



NOTES:

1. SOUNDINGS ARE EXPRESSED IN FEET AND TENTHS AND REFER TO M.L.L.W..
2. PROJECT SURVEYED WITH DISTRICT SURVEY VESSEL "SWART", USING RTK GPS HORIZONTAL POSITIONING EQUIPMENT AND 200 KHZ SOUNDING EQUIPMENT.
3. HORIZONTAL DATUM NAD 1983 - VERTICAL DATUM M.L.L.W.
4. THIS PROJECT WAS DESIGNED BY THE WILMINGTON DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS. THE INITIALS OR SIGNATURES AND REGISTRATION DESIGNATIONS OF INDIVIDUALS APPEAR ON THESE PROJECT DOCUMENTS WITHIN THE SCOPE OF THEIR EMPLOYMENT AS REQUIRED BY ER 1110-1-8152.
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7. FOR THE MOST UP TO DATE INFORMATION PLEASE CHECK OUR WEBSITE AT: WWW.SAW.USACE.ARMY.MIL

NAVIGATION AIDS

Type	Number	Survey Date	SPF_X	SPF_Y	DMS_X	DMS_Y
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Red Lighted Buoy	10	2013-03-08	2296625	38942	78° 1' 23.471" W	33° 51' 10.735" N
Green Lighted Buoy	11	2013-03-08	2297162	42943	78° 1' 16.641" W	33° 51' 50.252" N
Red Lighted Buoy	12	2013-03-08	2298239	43075	78° 1' 3.857" W	33° 51' 51.452" N

US Army Corps of Engineers
Wilmington District

SURVEY DATE(S): MARCH 8, 2013
SURVEYED BY: MAS, WWW
MAP DATE: MARCH 12, 2013
MAPPED BY: MSA
MAP SCALE: 1 : 2,000
IMAGERY DATE: FEBRUARY 28, 2013 © DIGITALGLOBE, INC.
MAP FILE NAME: BALDHEADSHOAL2_2013-03-08_AD.MXD

HYDROGRAPHIC SURVEY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WILMINGTON, NORTH CAROLINA

WILMINGTON HARBOR
BALDHEAD SHOAL - REACH 2

WILMINGTON, NORTH CAROLINA

APPENDIX E

PROJECT DESIGN DRAWINGS – PROPOSED ACTION

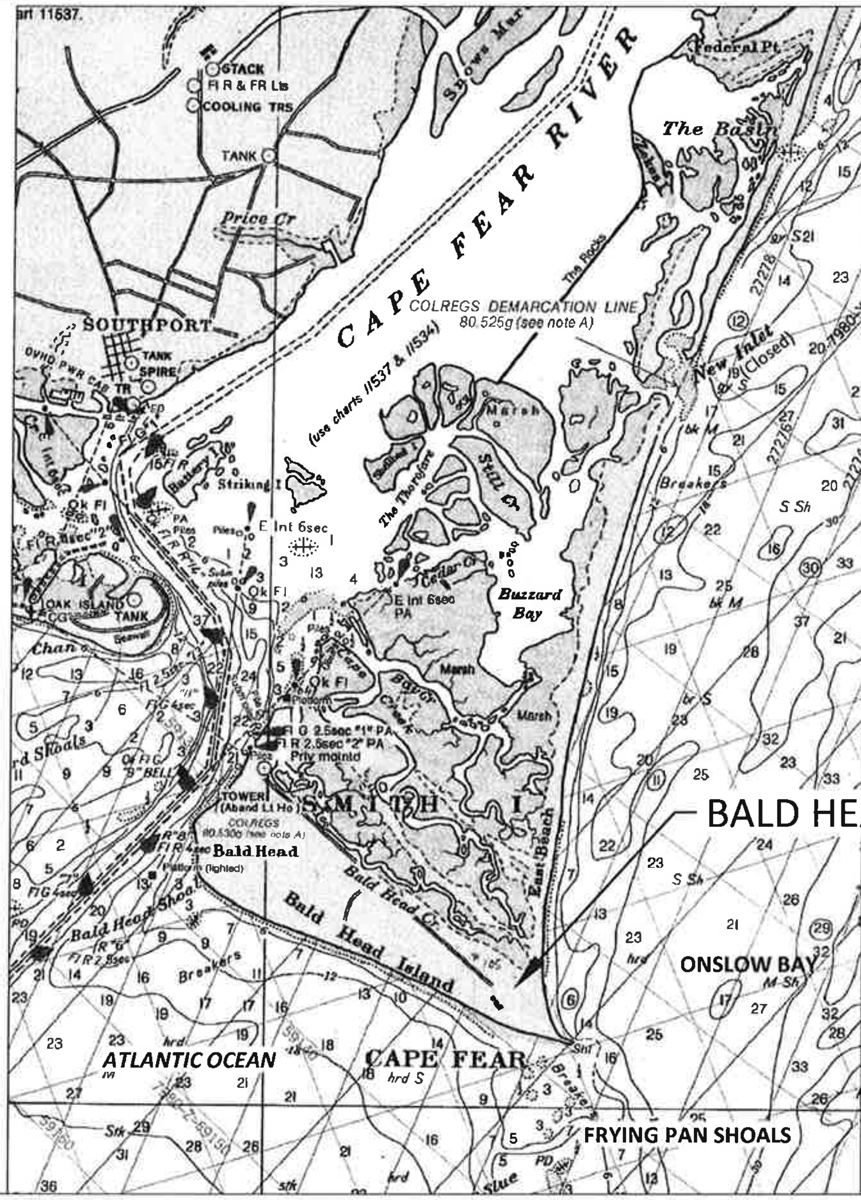
(Prepared by Olsen Associates, Inc.)

APPLICANT:
VILLAGE OF BALD HEAD ISLAND

ENGINEER:
OLSEN ASSOCIATES, INC.

AGENT:
ERIK J. OLSEN, P.E.

DATUM: MLLW



NTS

NOT FOR PURPOSES OF CONSTRUCTION

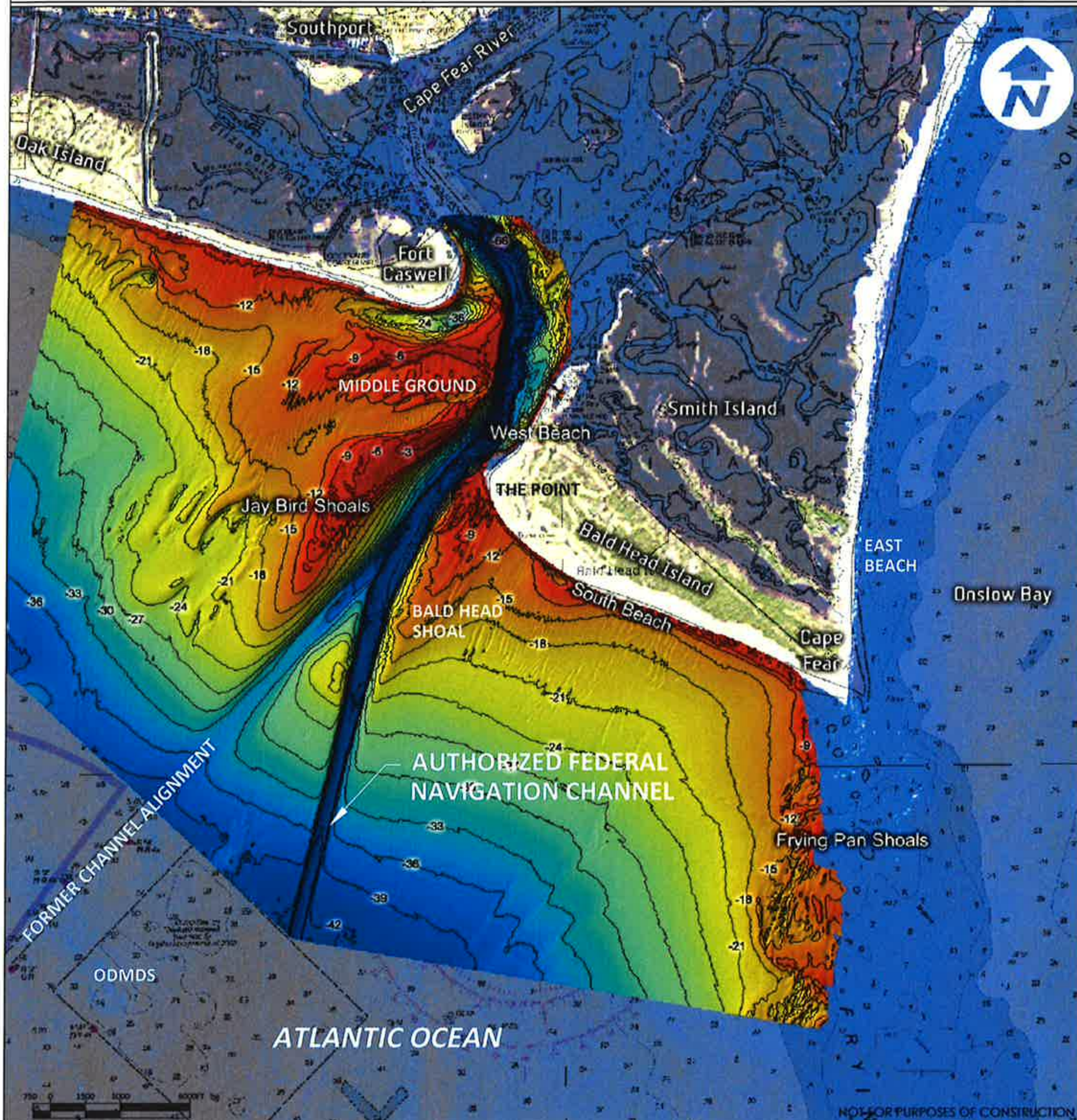
olsen associates, inc.
2618 Herschel Street
Jacksonville, FL. 32204
(904) 387-6114
C-1468

VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

PROJECT LOCATION

DATE	APPROVED	REVISION

09/30/2013
DRAWN BY: ML
SHEET 1 of 21



2006 SURVEY-GEODYNAMICS, INC

2006 CONTOUR DATUM: NGVD 29
NAUTICAL CHART DATUM: MLLW

NOT FOR PURPOSES OF CONSTRUCTION

olsen associates, inc.
2618 Herschel Street
Jacksonville, FL. 32204
(904) 387-6114
C-1468

VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

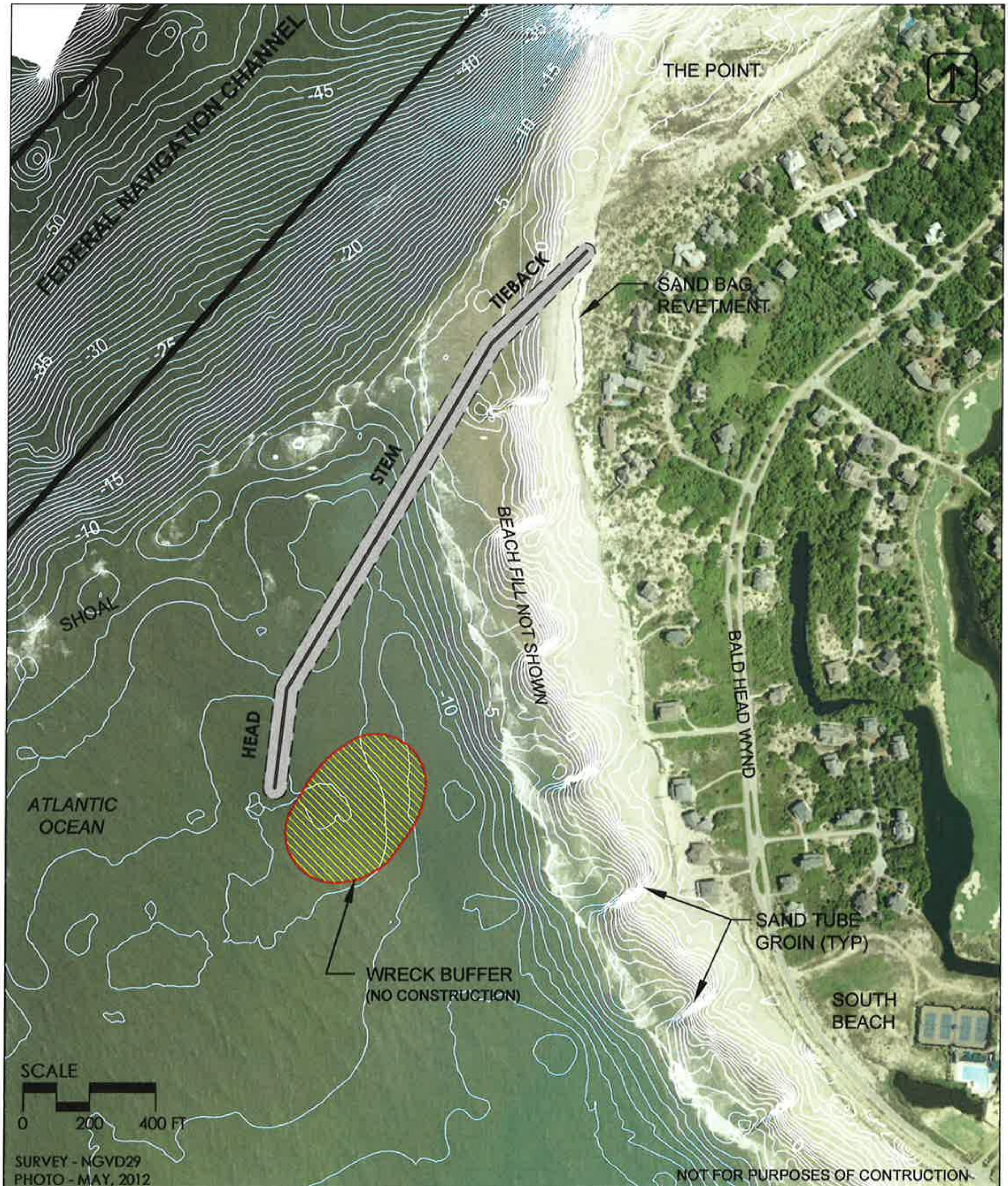
SITE CONDITIONS

DATE	APPROVED	REVISION

09/30/2013

DRAWN BY: ML

SHEET 2 of 21



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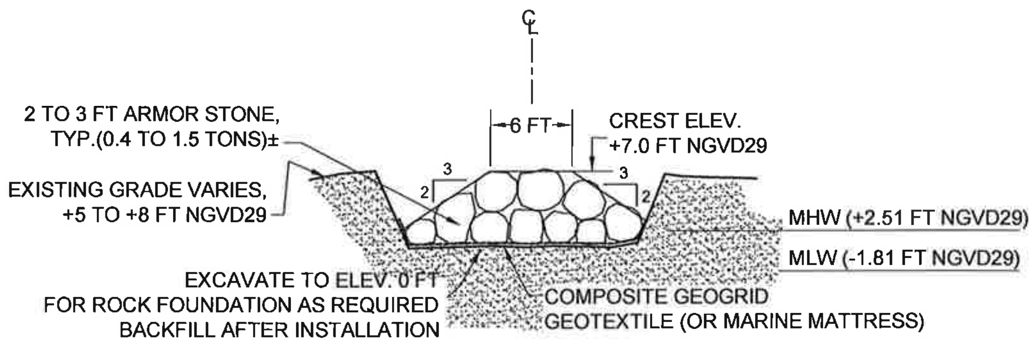
VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

GROIN LOCATION AND CONFIGURATION

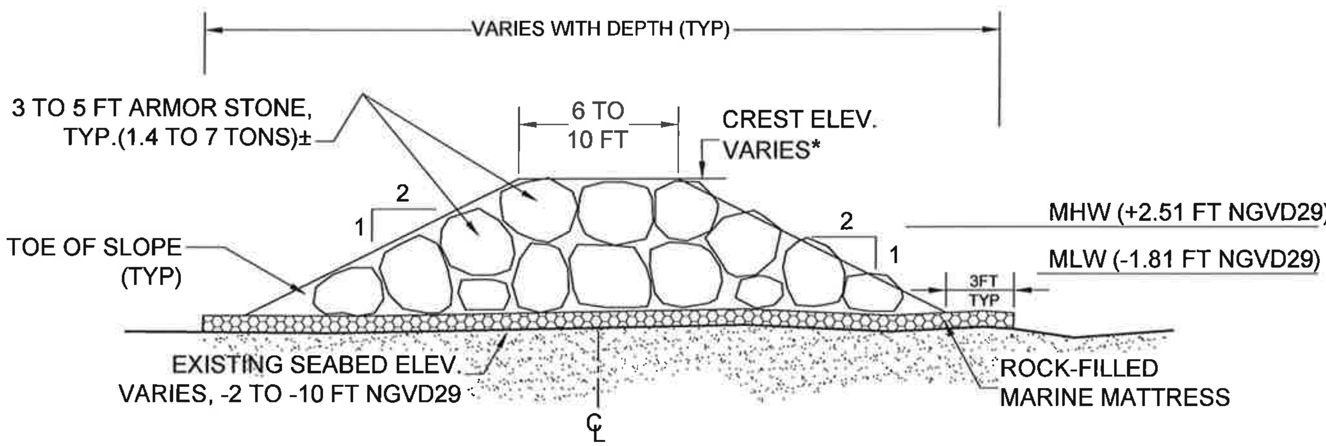
DATE	APPROVED	REVISION	09/30/2013
			DRAWN BY: ML
			SHEET 3 of 21

		DATE	APPROVED	REVISION	
olsen associates, inc. 2618 Herschel Street Jacksonville, FL. 32204 (904) 387-6114 C-1468	VILLAGE OF BALD HEAD ISLAND TERMINAL GROIN PROJECT **GROIN DESIGN SECTION LOCATIONS**				09/30/2013 DRAWN BY: ML SHEET 4 of 21



NTS

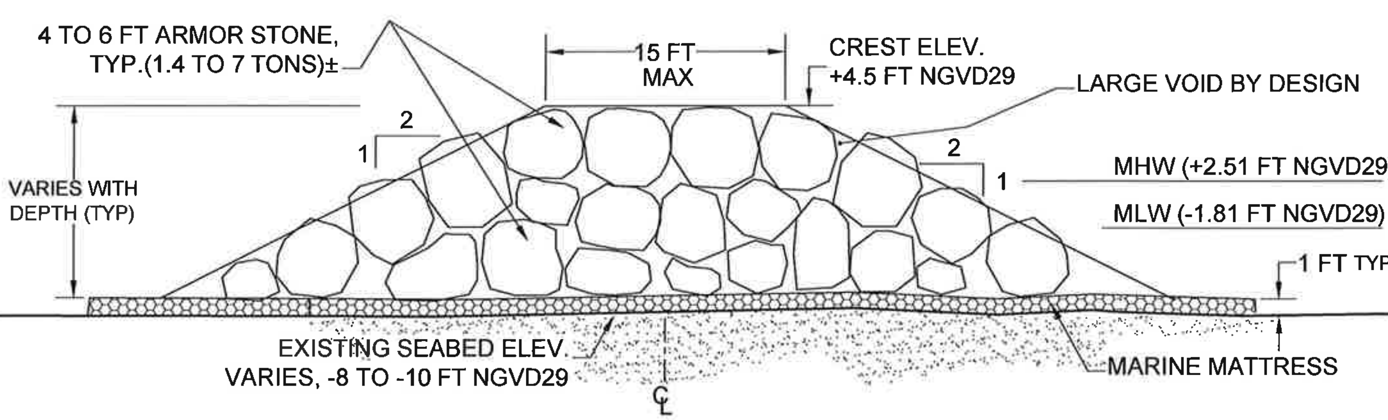
TIE BACK SECTION (A-A)



NTS

STEM SECTION (B-B)

* STEM ELEV VARIES
FROM +4.5FT TO +7.0FT



NTS

HEAD SECTION (C-C)

CL - CENTERLINE (TYP)

DATUM: NGVD'29

NOTE: 1) CREST ELEVATION VARIES
ALONG STRUCTURE PROFILE

NOT FOR PURPOSES OF CONSTRUCTION - SUBJECT TO DESIGN REVISIONS BASED UPON SITE CONDITIONS

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

TYPICAL CROSS SECTIONS

DATE	APPROVED	REVISION

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5 of 21

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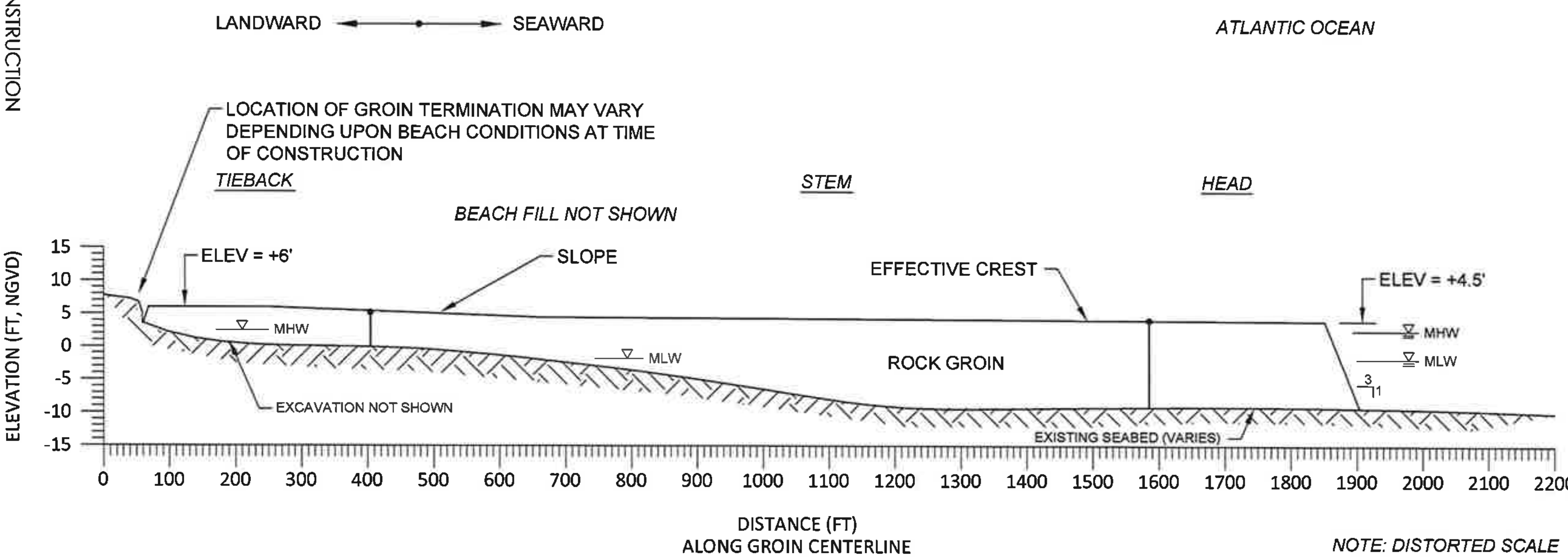
TIDAL DATUMS

MHHW = 2.82 FT
MHW = 2.51 FT
MTL = 0.35 FT
NGVD = 0.00 FT
MLW = -1.81 FT
MLLW = -1.98 FT



NOTE: DISTORTED SCALE

CENTERLINE SECTION (D-D)

NOTES:
1) NOT FOR PURPOSES OF CONTRUCTION
2) FINAL DESIGN ELEVATIONS MAY VARY
3) THE STRUCTURE STEM MAY HAVE MULTIPLE SLOPES AND ELEVATIONS
4) LENGTH IS COMPUTED ALONG GROIN CENTERLINE
5) GROIN LENGTH IS NOT SHORE NORMAL
6) THE STRUCTURE MAY BE CONSTRUCTED IN TWO PHASES
7) A TEMPORARY TRESTLE MAY BE INSTALLED DURING THE PERIOD OF CONSTRUCTION
8) TOTAL STRUCTURE LENGTH: 1900 FT

DATUM - NGVD1929

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

GROIN PROFILE

DATE	APPROVED	REVISION

09/30/2013

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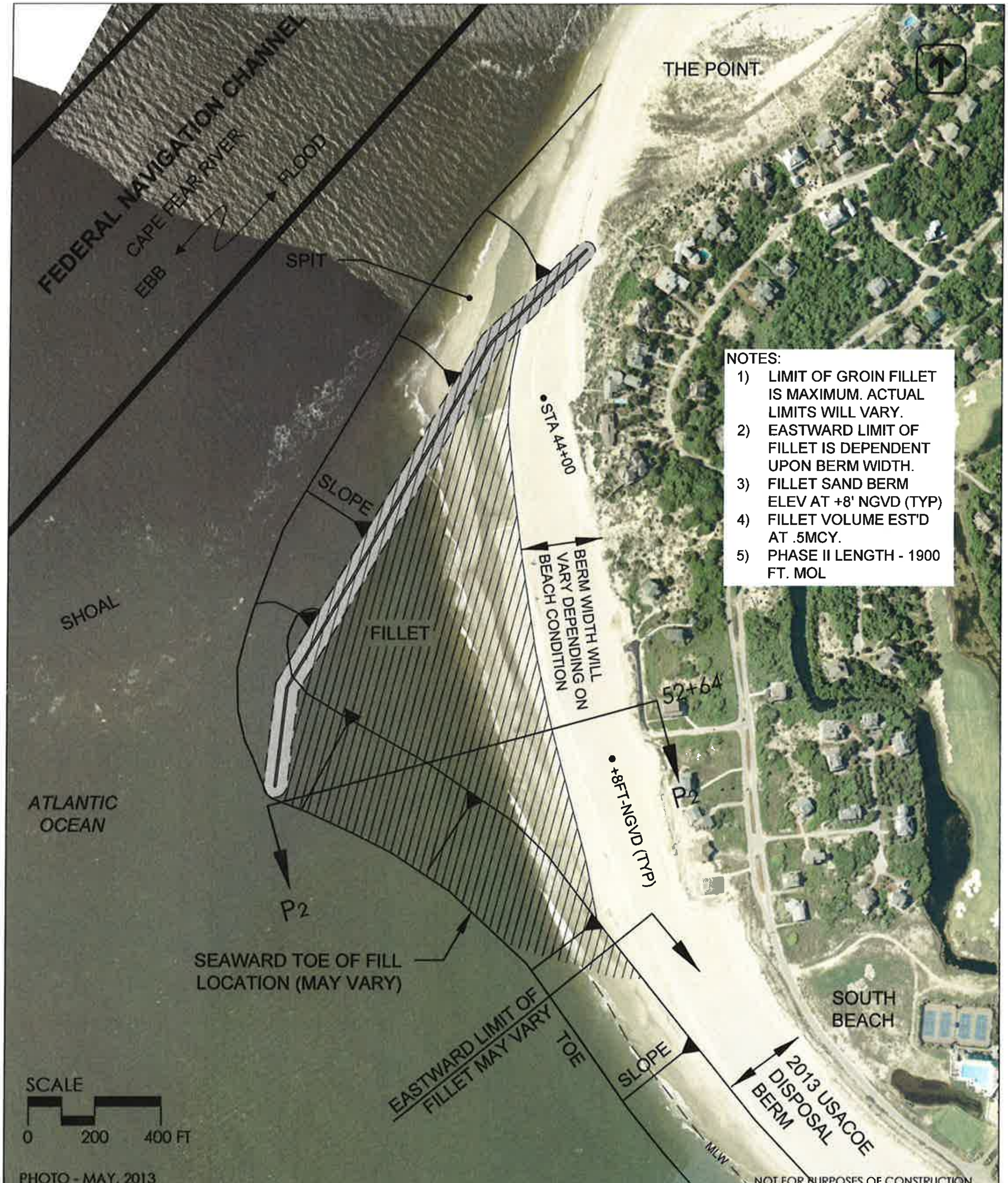

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT
PHASE II GROIN FILLET
(MAXIMUM SEAWARD EXTENT)

DATE	APPROVED	REVISION

09/30/2013

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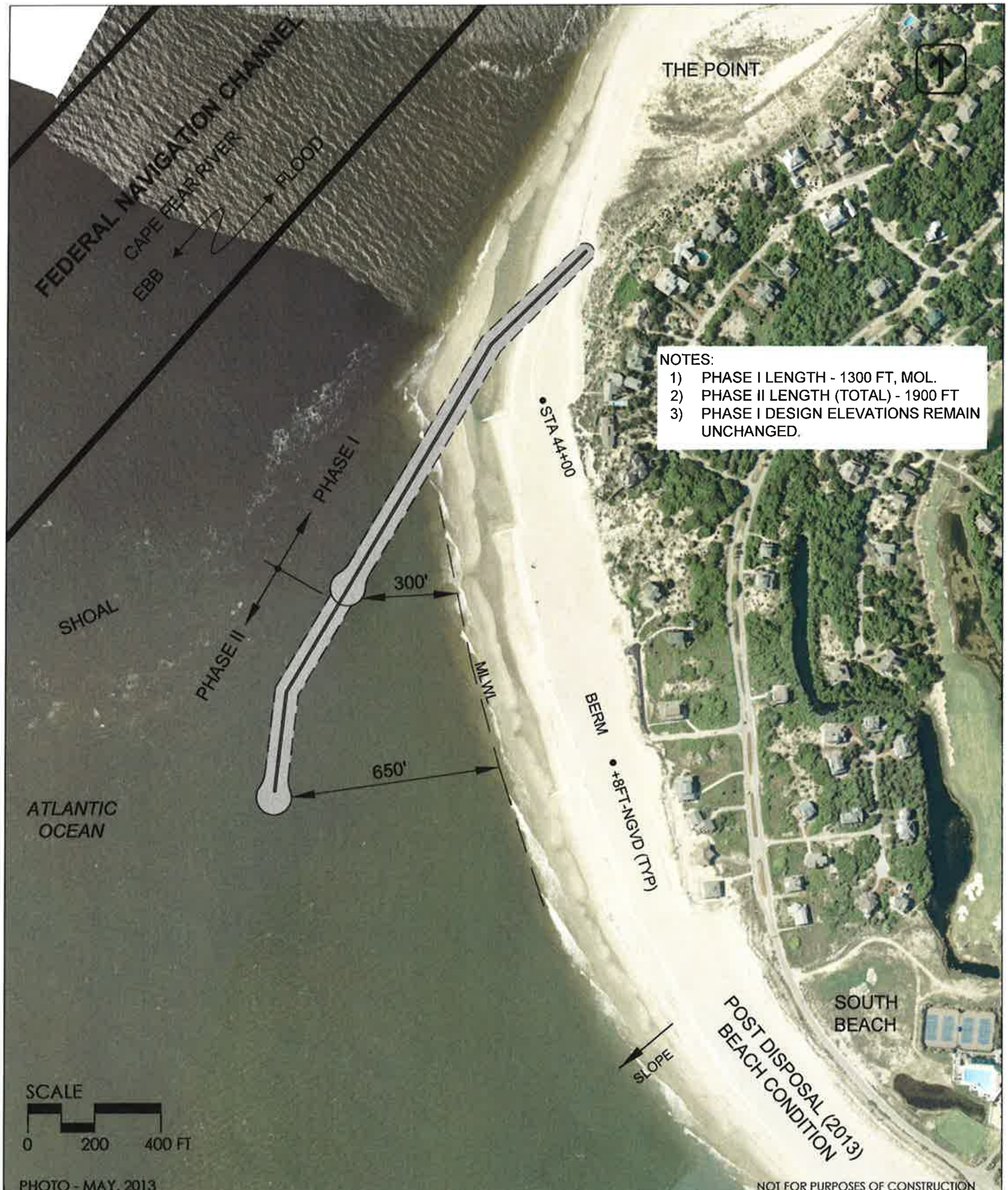

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

PHASED GROIN PLAN

DATE	APPROVED	REVISION

09/30/2013

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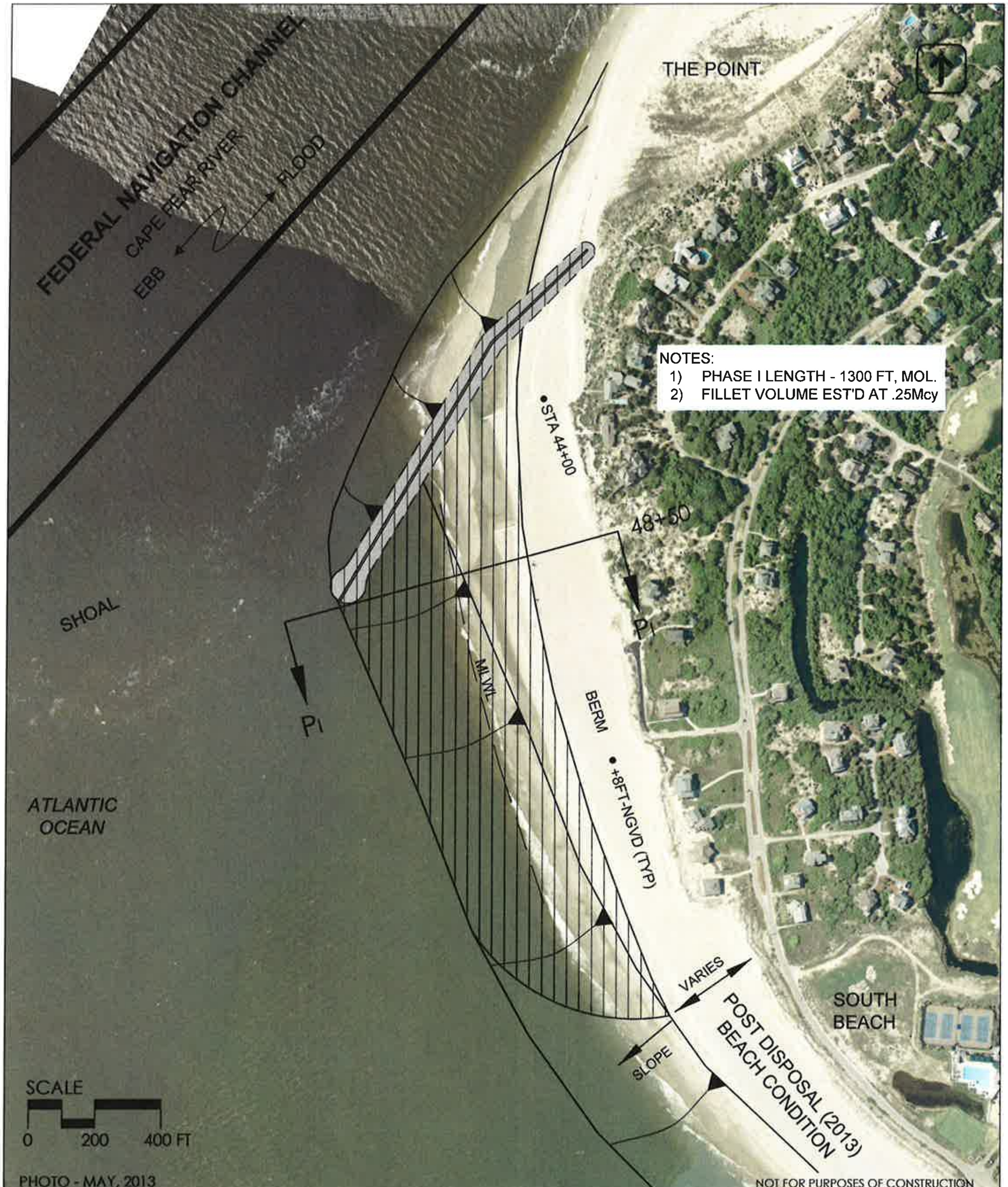
SHEET 8 of 21



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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

PHASE I GROIN FILLET
(INITIAL SEAWARD EXTENT)

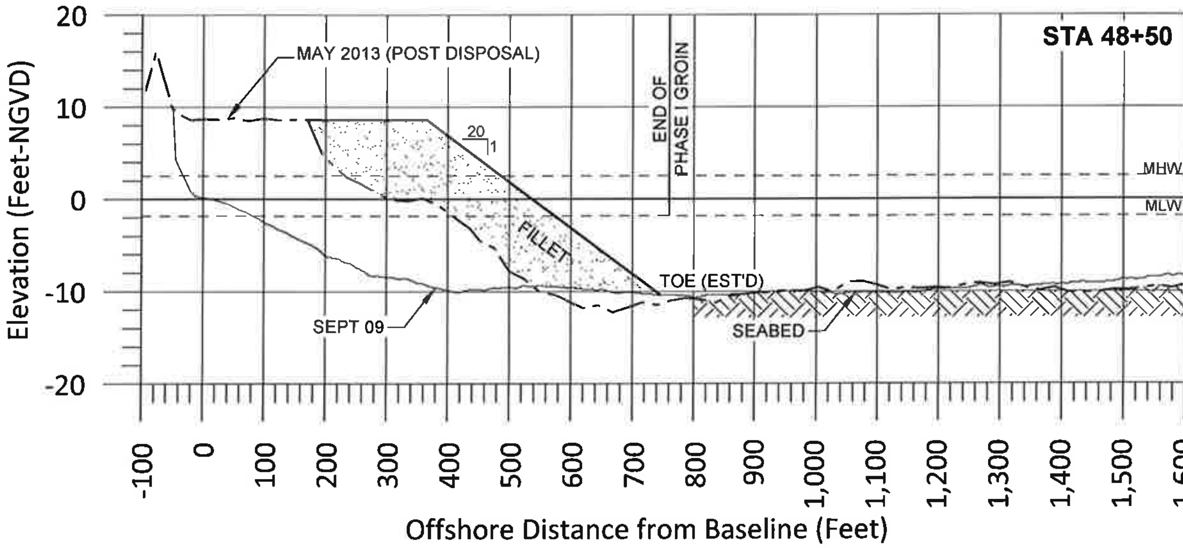
DATE	APPROVED	REVISION

09/30/2013

DRAWN BY: ML

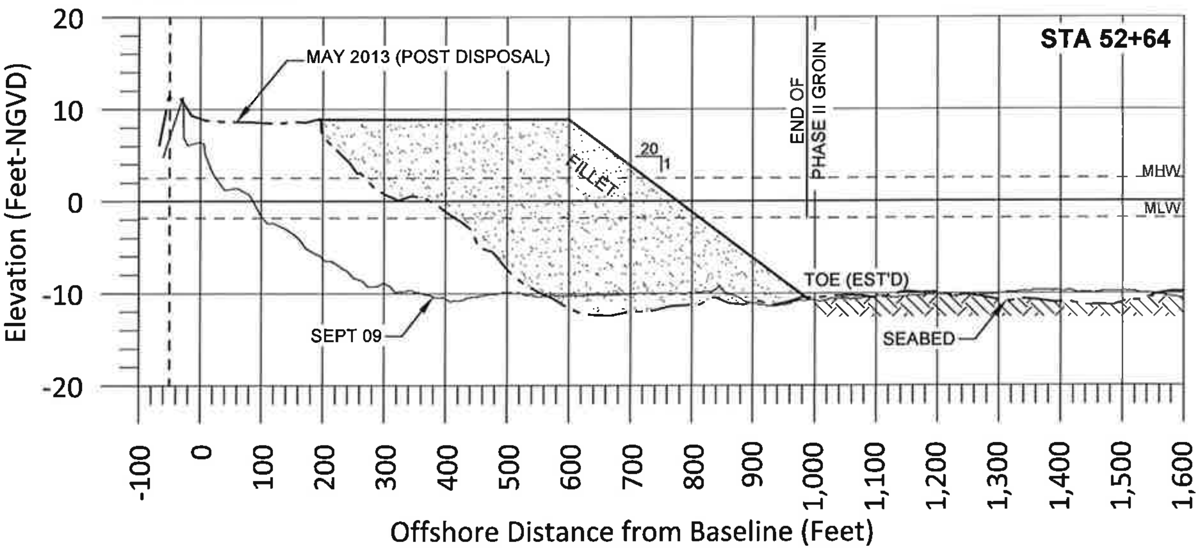
SECTION P1-P1

PHASE I GROIN



SECTION P2-P2

PHASE II GROIN



NOTES:

1. SEPT. '09 SURVEY FOR REFERENCE ONLY
2. MAY '13 SURVEY - POST DISPOSAL

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

SAND FILLET SECTIONS

DATE	APPROVED	REVISION

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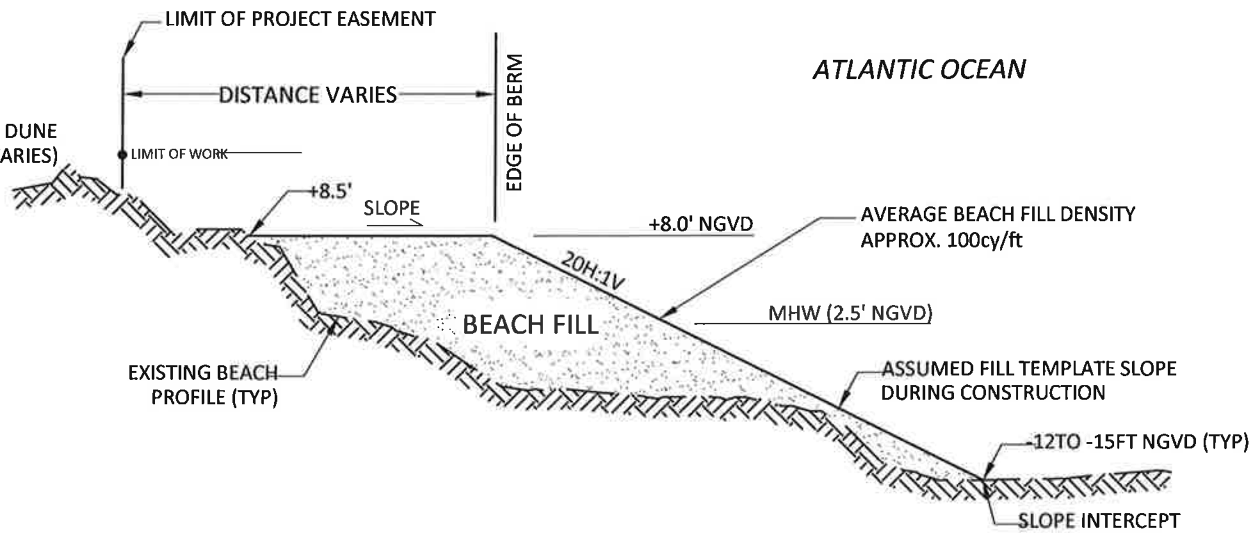
SOUTH BEACH



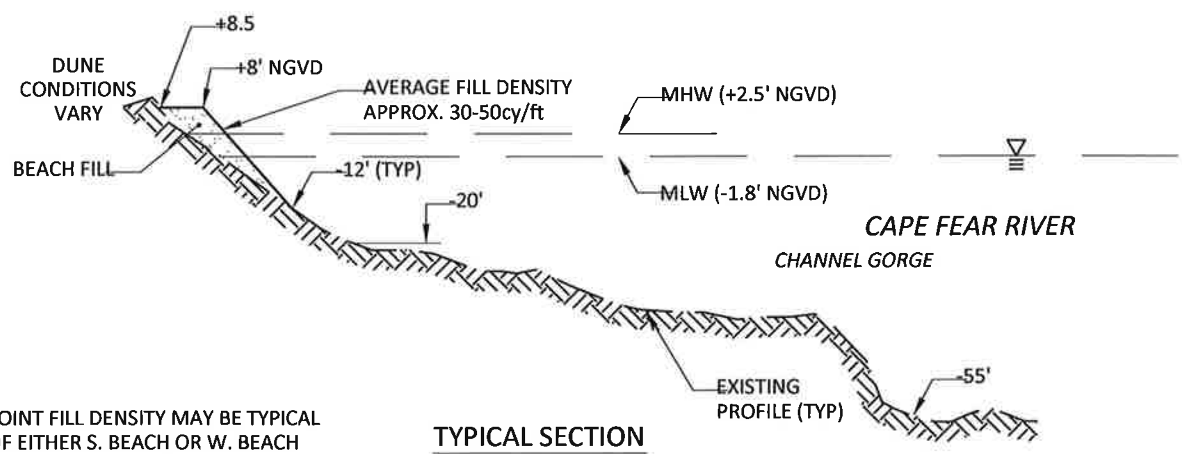
TYPICAL SECTION

NOTE:
1) FILL DENSITY TO VARY SPATIALLY DEPENDING ON CONDITION OF BEACH AT TIME OF CONSTRUCTION.
2) GROIN FILLET FILL DENSITY VARIES AND MAY EXCEED 300 CY/FT

NTS
DATUM: NGVD 29

LOCAL TIDAL DATUMS (FT)
MHHW +2.8
MHW +2.5
NAVD +1.1
NGVD(29) 0.0
MLW -1.8
MLLW -2.0

WEST BEACH



NOTE:
1) POINT FILL DENSITY MAY BE TYPICAL OF EITHER S. BEACH OR W. BEACH

TYPICAL SECTION

NTS
DATUM: NGVD 29
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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

TYPICAL BEACH FILL SECTIONS

DATE	APPROVED	REVISION

09/30/2013
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SHEET 11 of 21

SCALE

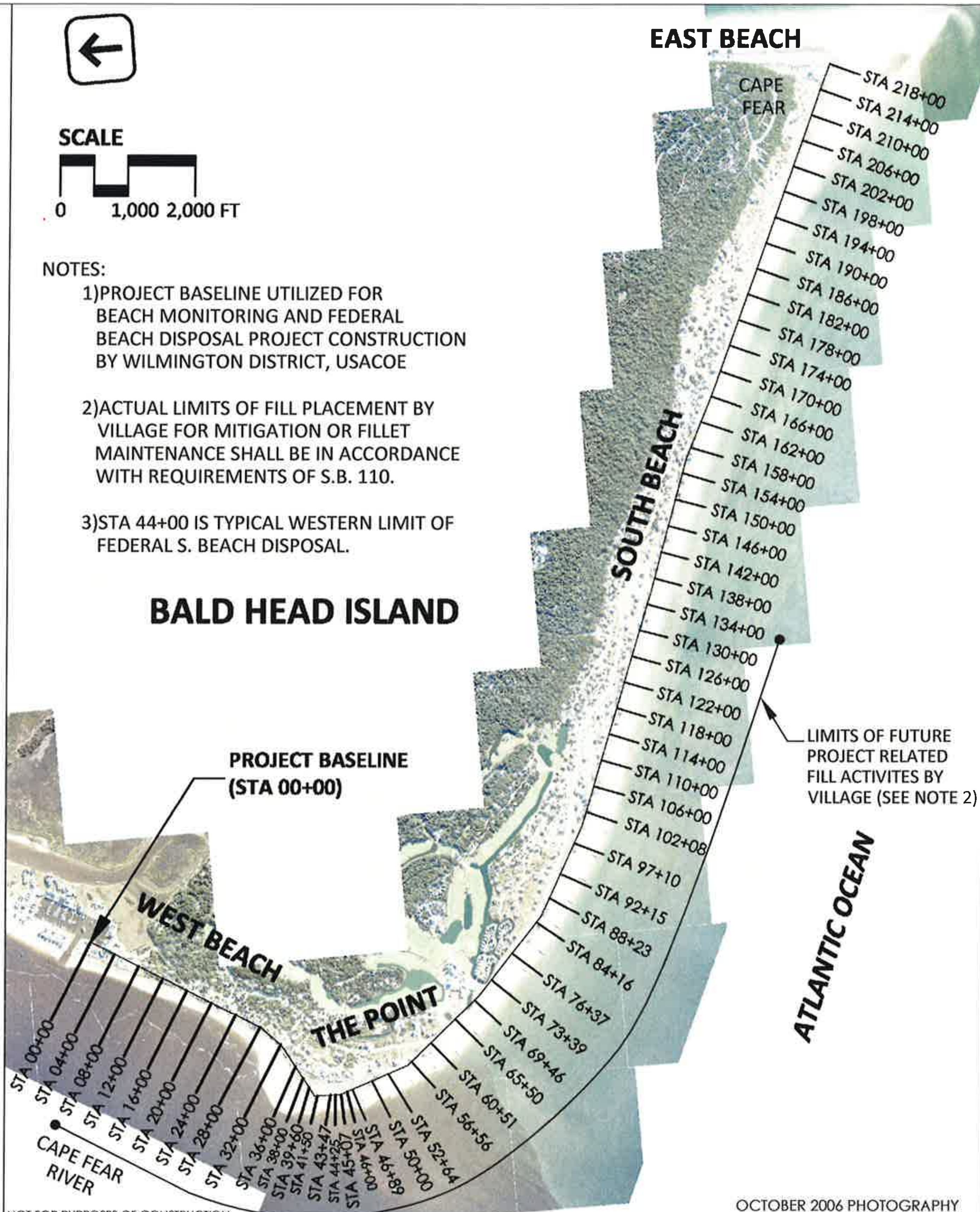
0 1,000 2,000 FT

NOTES:

1) PROJECT BASELINE UTILIZED FOR BEACH MONITORING AND FEDERAL BEACH DISPOSAL PROJECT CONSTRUCTION BY WILMINGTON DISTRICT, USACOE

2) ACTUAL LIMITS OF FILL PLACEMENT BY VILLAGE FOR MITIGATION OR FILLET MAINTENANCE SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF S.B. 110.

3) STA 44+00 IS TYPICAL WESTERN LIMIT OF FEDERAL S. BEACH DISPOSAL.



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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT
PROJECT BASELINE AND LIMITS OF FILL

DATE	APPROVED	REVISION

09/30/2013

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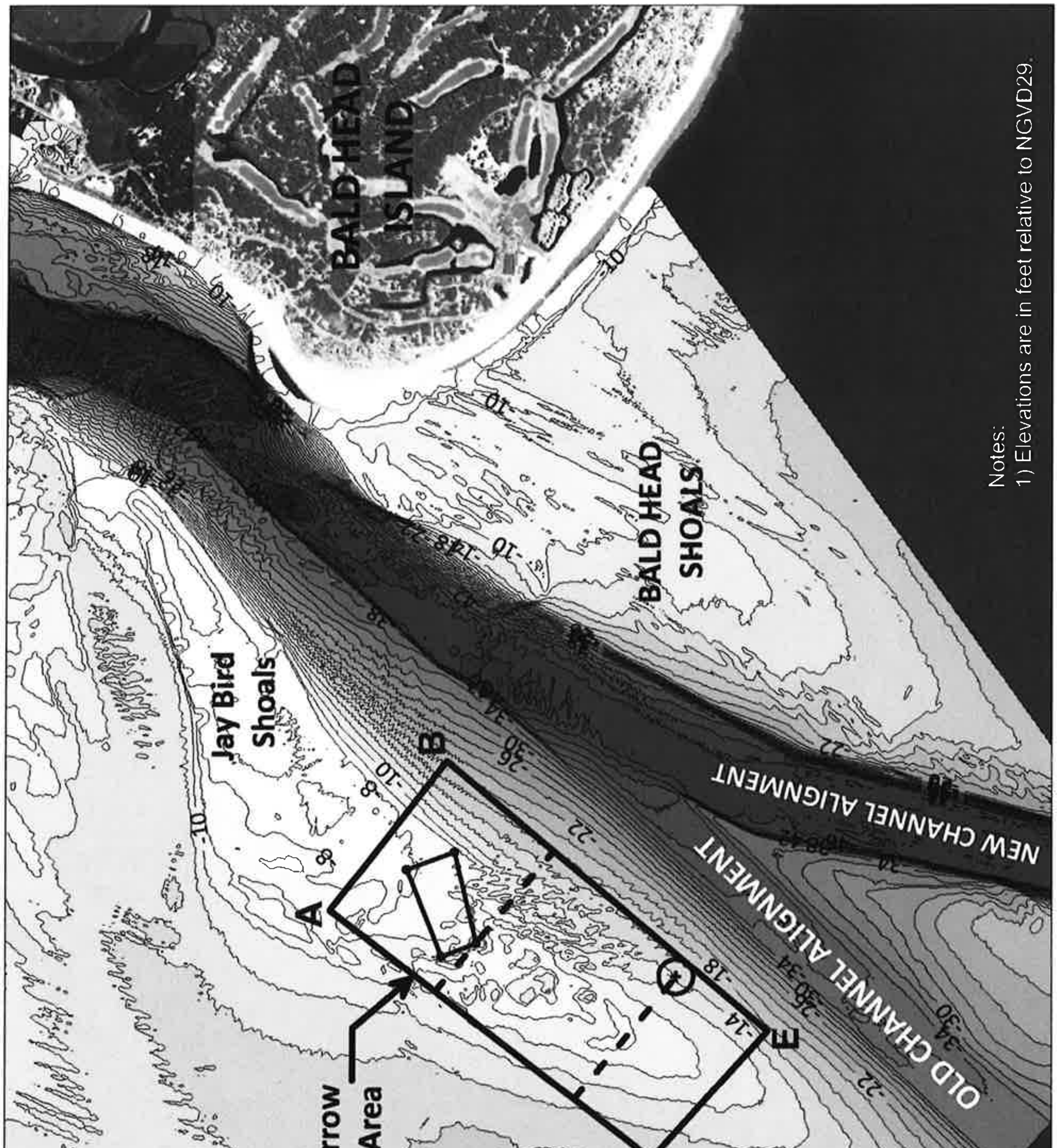
SHEET 12 of 21



VBHI RESTORATION PROJECT
2009 BORROW SITE PERMITS:
- CAMA-67-09
- COE-2007-02699

2009 PROJECT PERMITTED BORROW AREA - A,B,E,F
TERMINAL GROIN BORROW SITE

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

JAY BIRD SHOALS BORROW AREA

DATE	APPROVED	REVISION

09/30/2013

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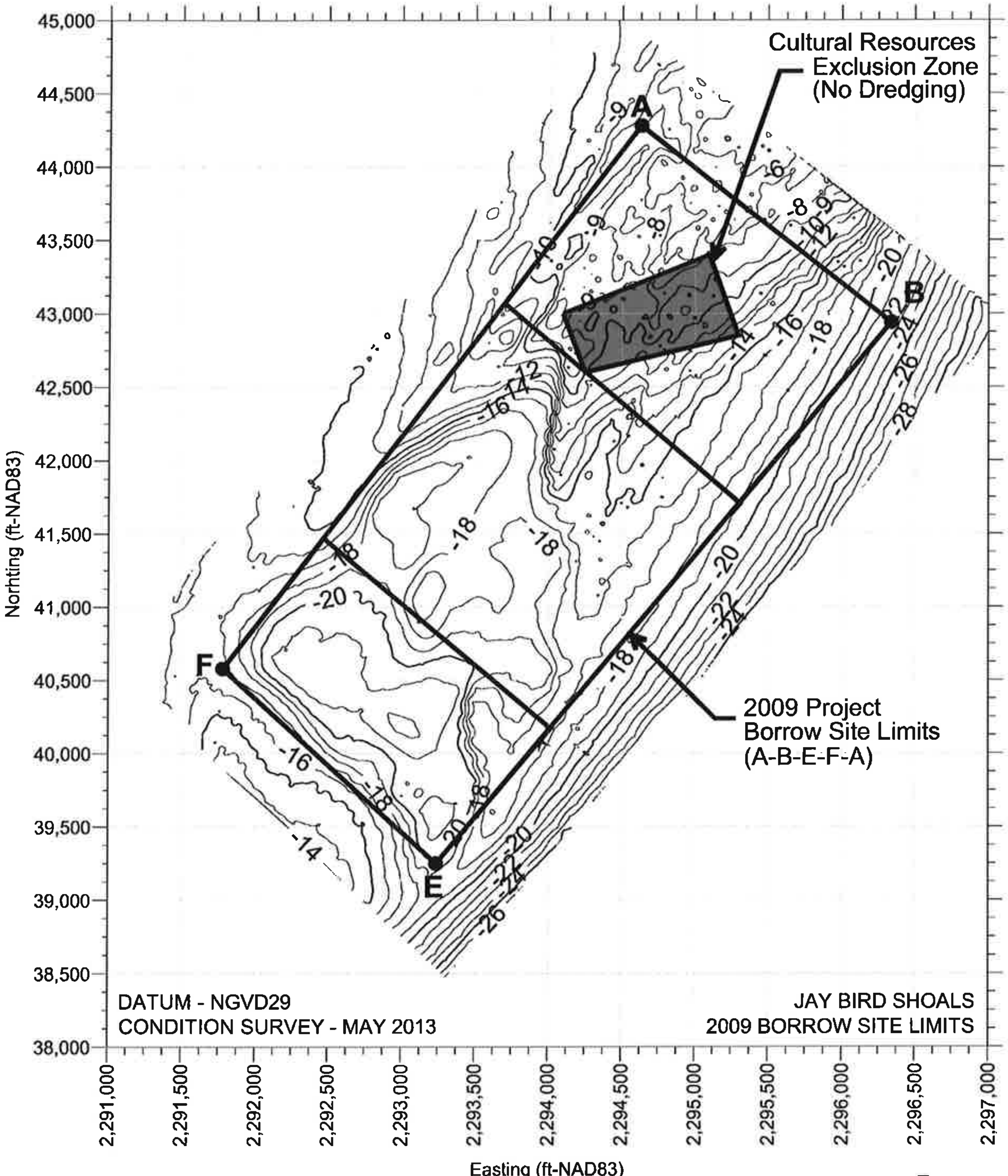
SHEET 13 of 21



VBHI RESTORATION PROJECT
2009 BORROW SITE PERMITS:

- CAMA-67-09
- COE-2007-02699

	E	N
A	2,294,630	44,280
B	2,296,340	42,940
E	2,293,240	39,250
F	2,291,780	40,580

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

2013 BORROW AREA CONDITION SURVEY

DATE	APPROVED	REVISION

09/30/2013

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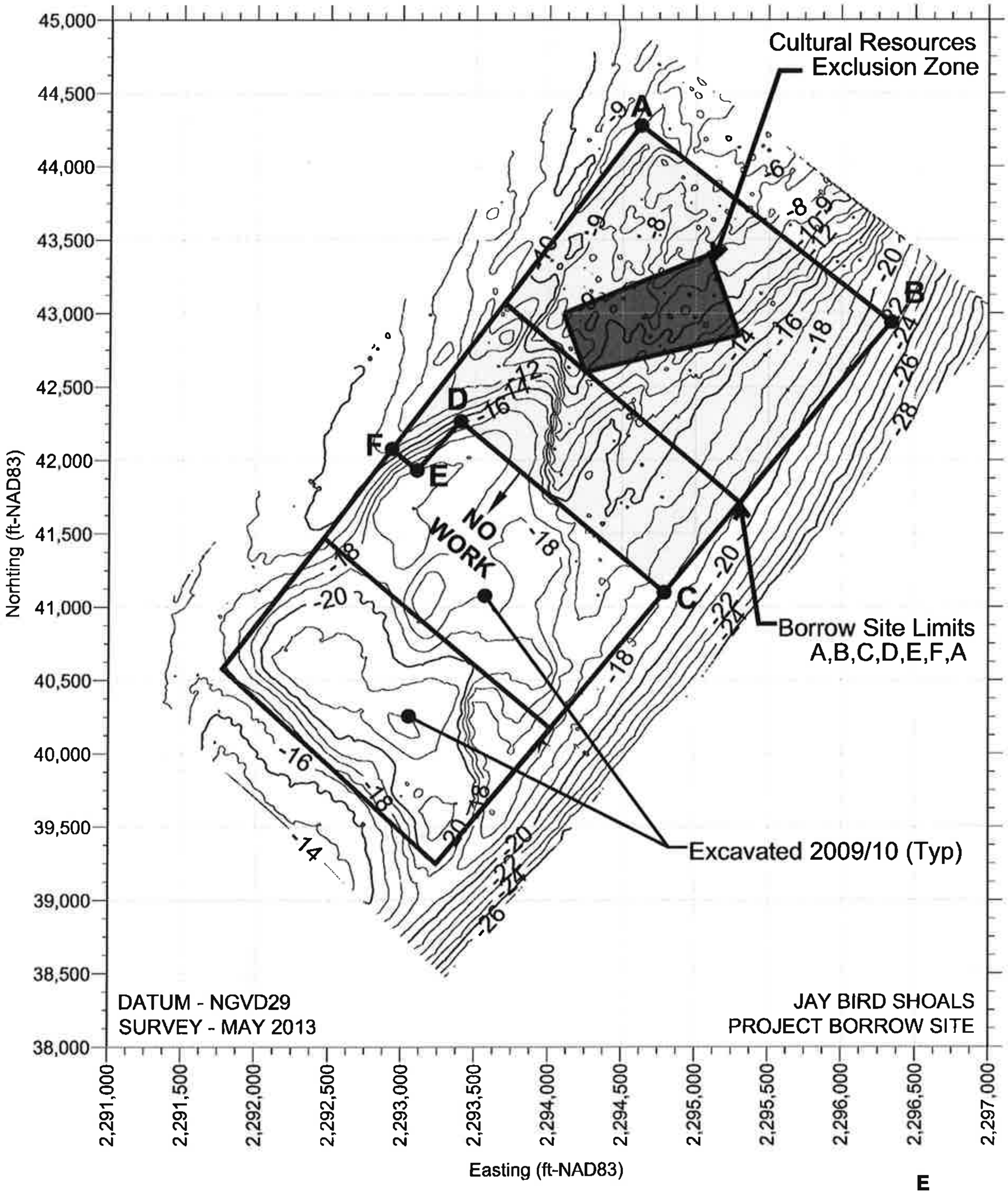

VBHI RESTORATION PROJECT
2009 BORROW SITE PERMITS:

- CAMA-67-09
- COE-2007-02699

	E	N
A	2,294,630	44,280
B	2,296,340	42,940
C	2,294,790	41,100
D	2,293,400	42,260
E	2,293,100	41,930
F	2,292,930	42,080

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

PROJECT BORROW SITE

DATE	APPROVED	REVISION

09/30/2013

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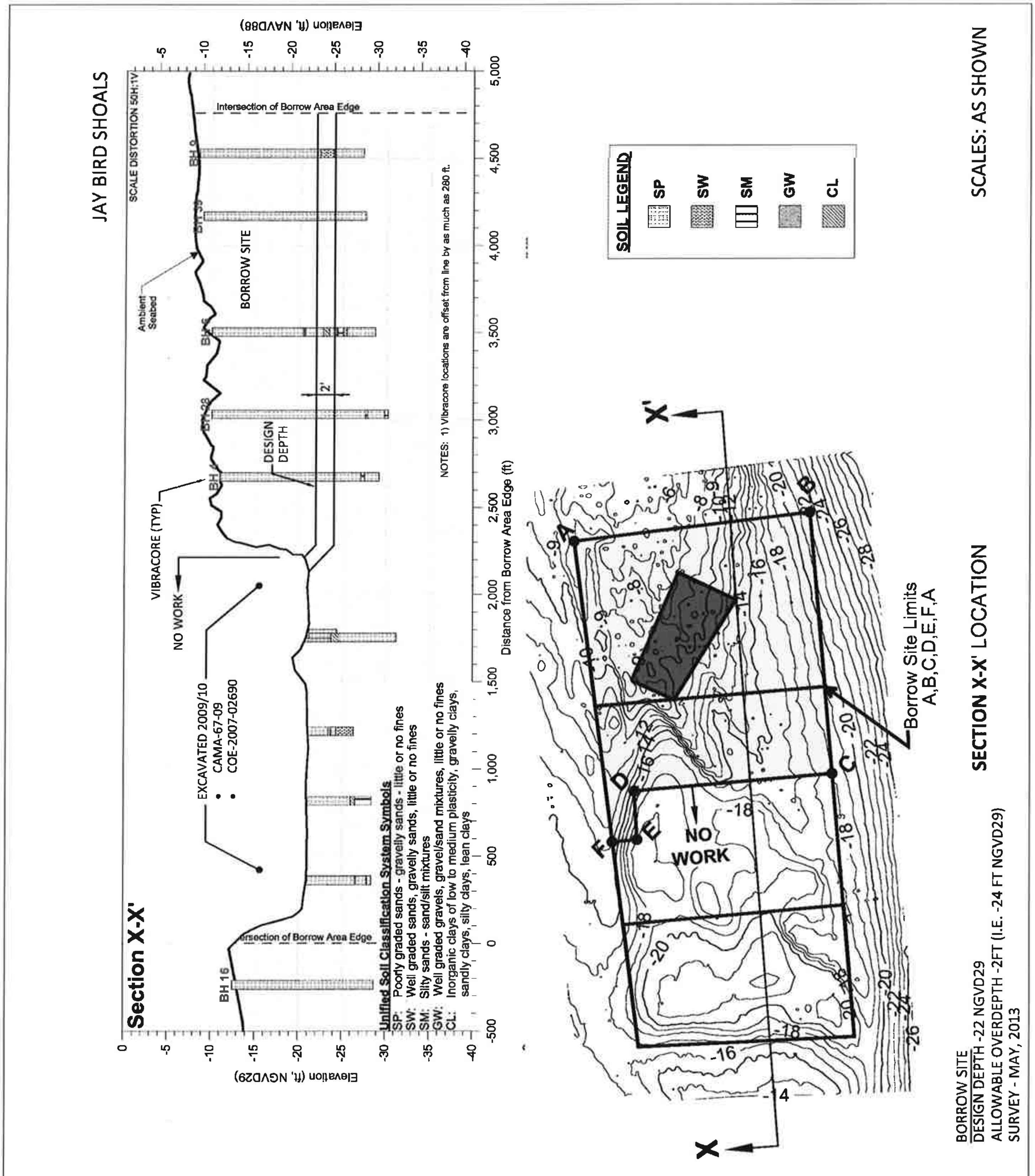

JAY BIRD SHOALS BORROW SITE

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

BORROW SITE TYPICAL SECTION

DATE	APPROVED	REVISION

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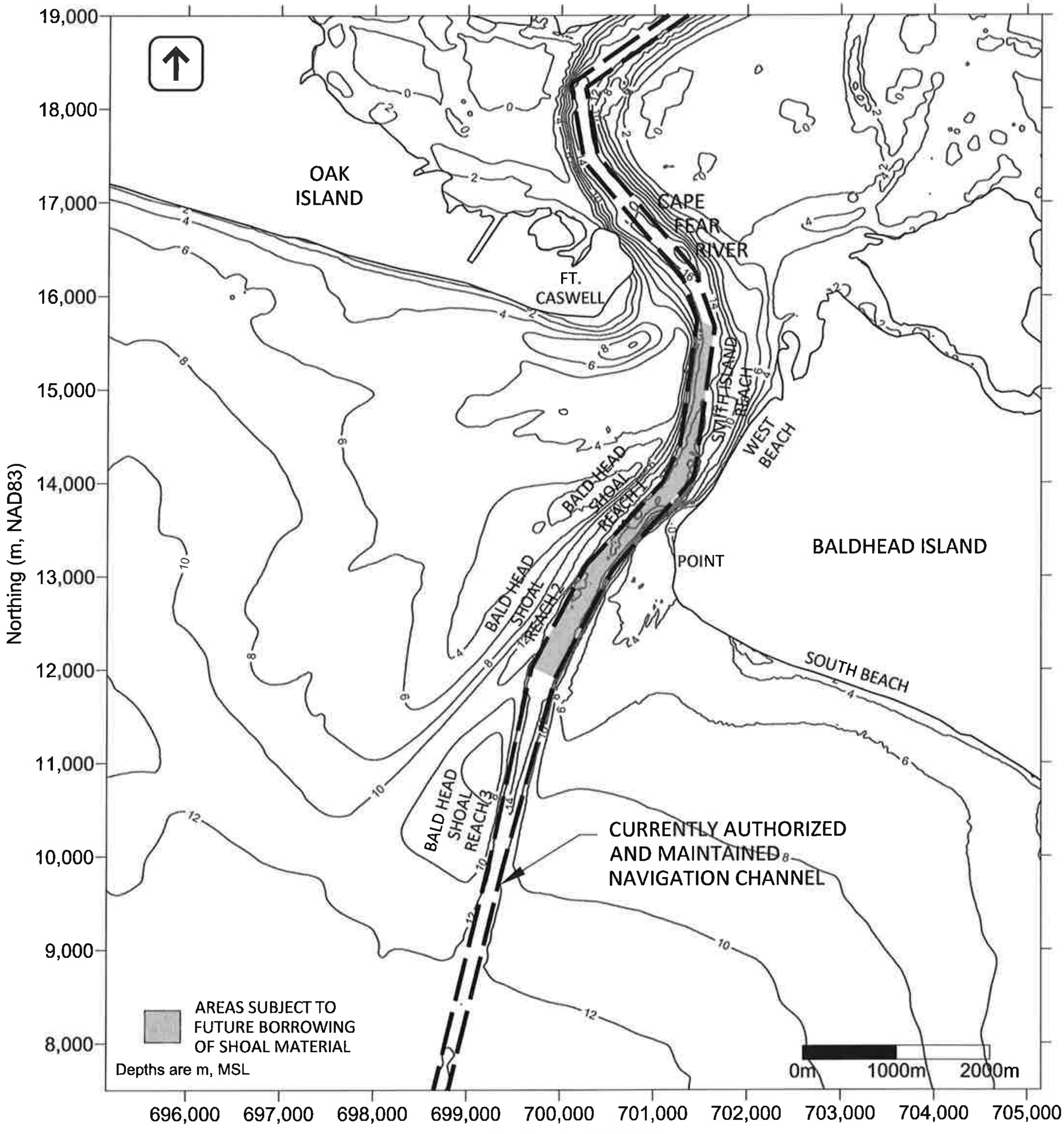

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

NAVIGATION PROJECT BORROW AREAS

DATE	APPROVED	REVISION

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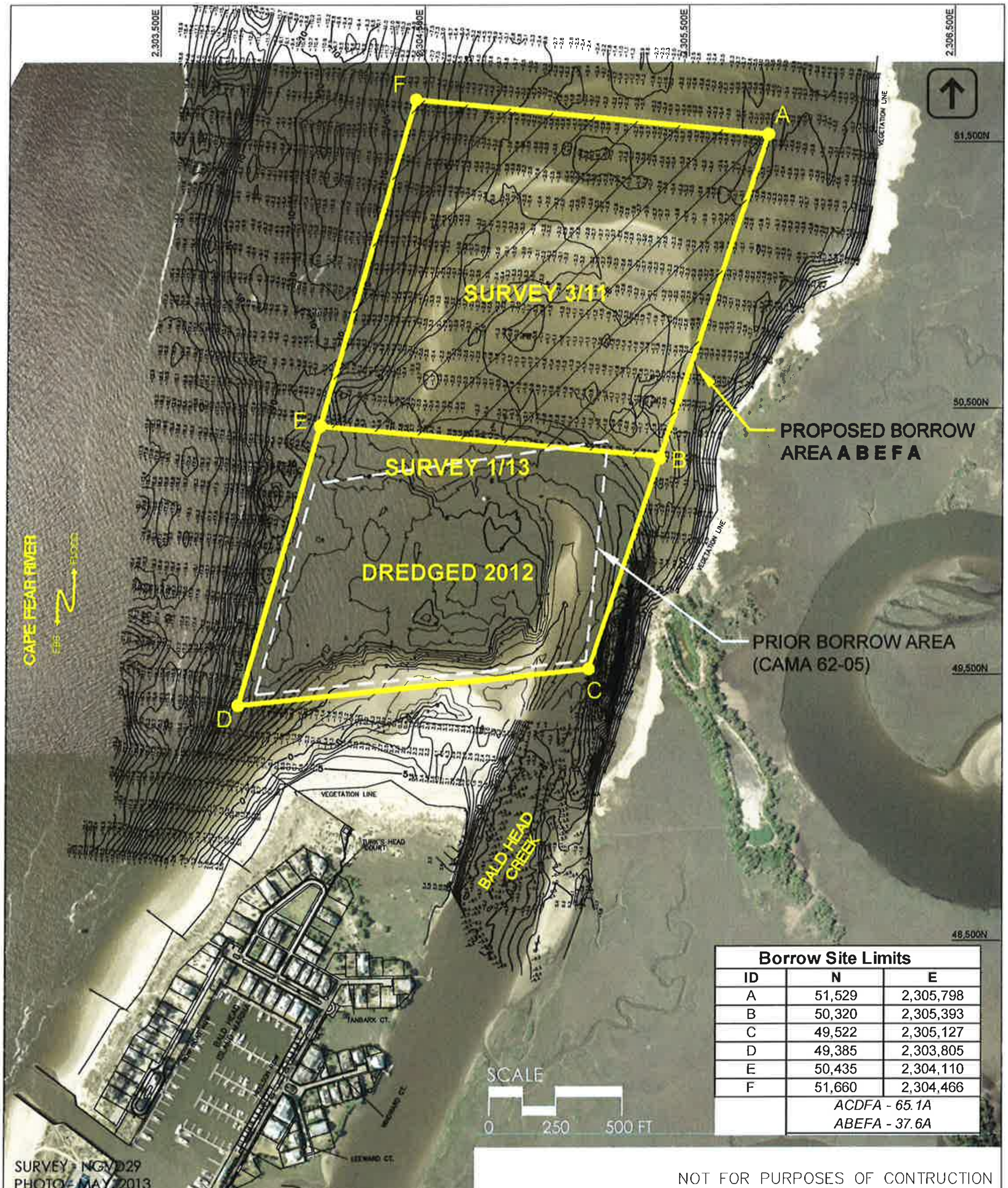

Borrow Site Limits

ID	N	E
A	51,529	2,305,798
B	50,320	2,305,393
C	49,522	2,305,127
D	49,385	2,303,805
E	50,435	2,304,110
F	51,660	2,304,466
	ACDFA - 65.1A	
	ABEFA - 37.6A	

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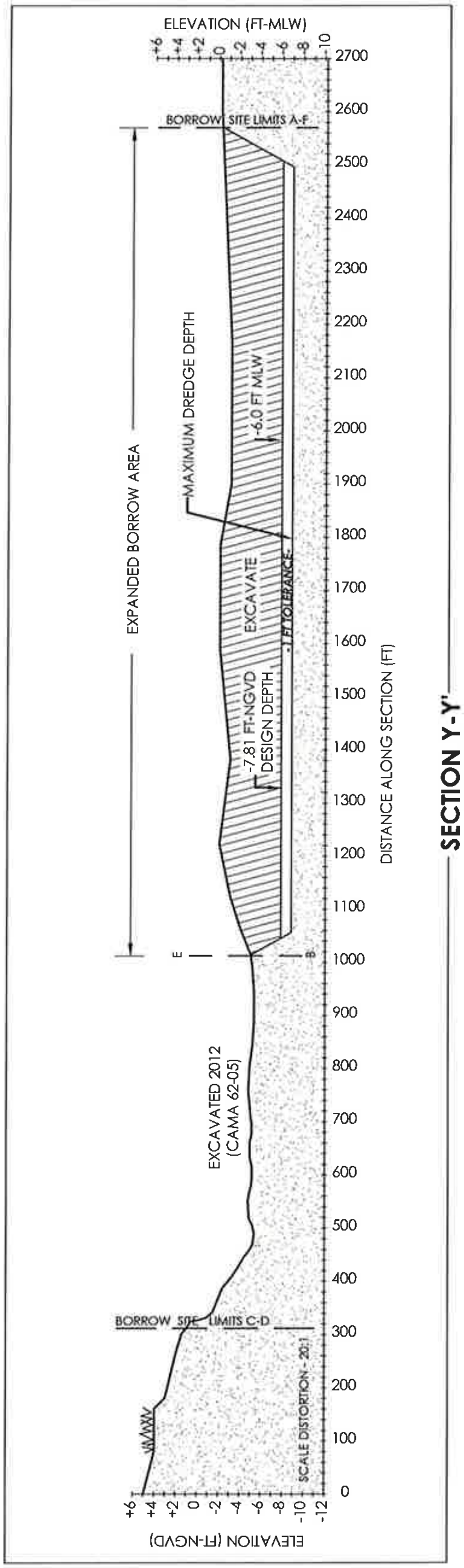
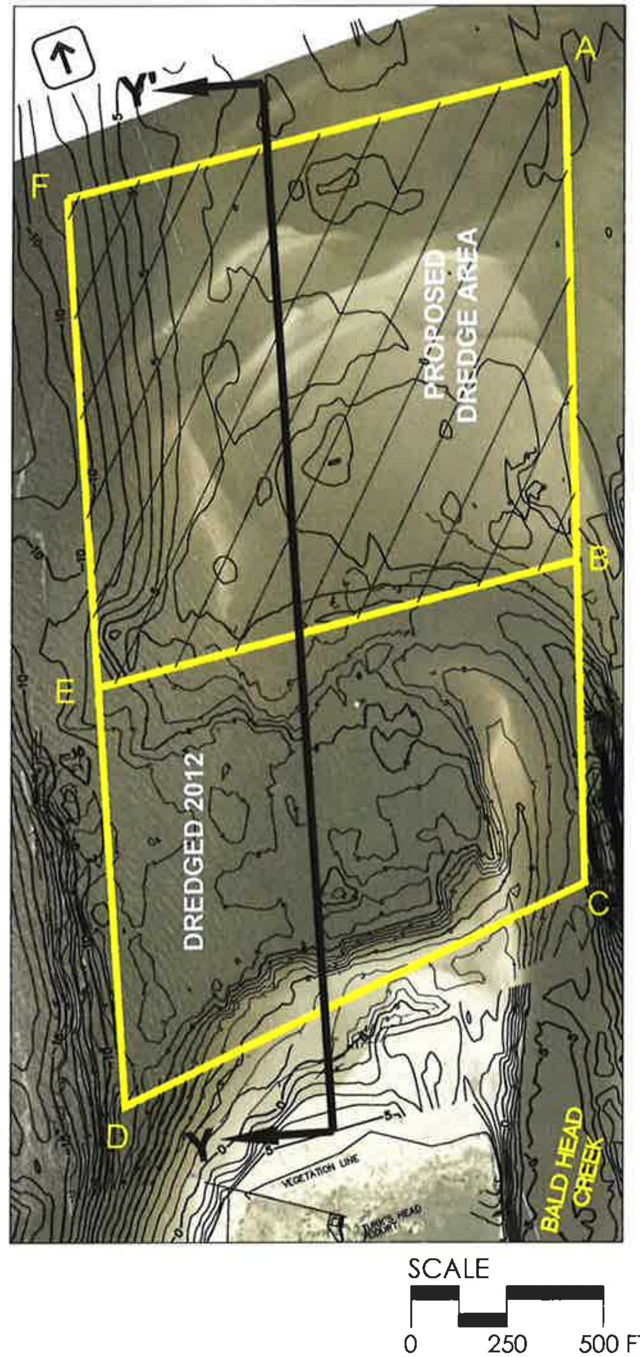
VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT
BALD HEAD CREEK
BORROW AREA

DATE	APPROVED	REVISION	
			10/18/13
			DRAWN BY: ML
			SHEET 18 of 21





SURVEY - NGVD29
PHOTO - MAY, 2013

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT
BALD HEAD CREEK BORROW SITE
TYPICAL SECTION

DATE	APPROVED	REVISION

10/18/13
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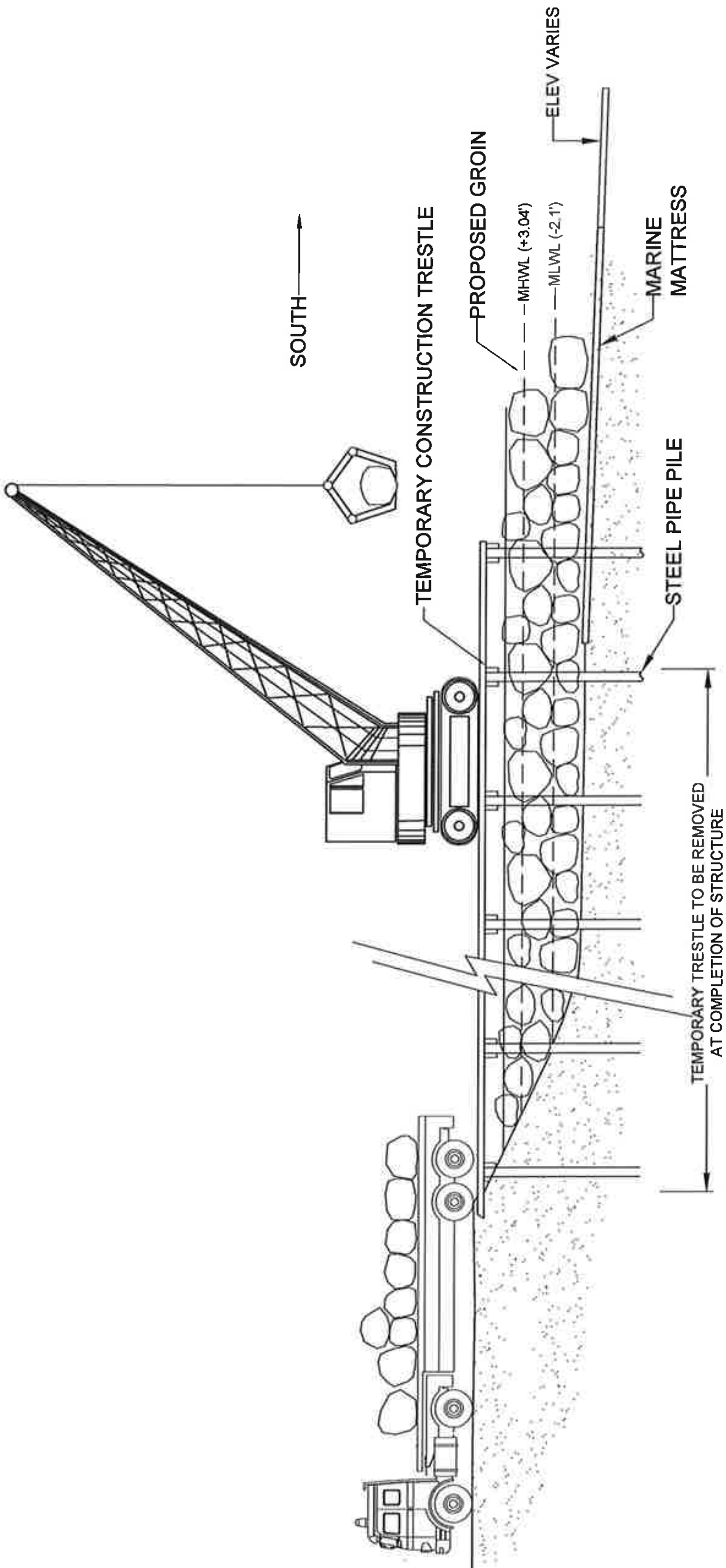

TYPICAL TRESTLE INSTALLATION - OPTIONAL

NOTE:
1) TRESTLE SHALL BE CONSTRUCTED ALONGSIDE ROCK GROIN.
2) TRESTLE LENGTH TO BE DETERMINED BY BEACH CONDITIONS AT TIME OF CONSTRUCTION.
3) TRESTLE MAY NOT ENTER CULTURAL RESOURCE BUFFER AREA (SEE SHEET 3).
4) ALL TRESTLE MATERIAL TO BE REMOVED FROM SITE.

NOT FOR PURPOSES OF CONSTRUCTION

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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

TEMPORARY TRESTLE

DATE	APPROVED	REVISION

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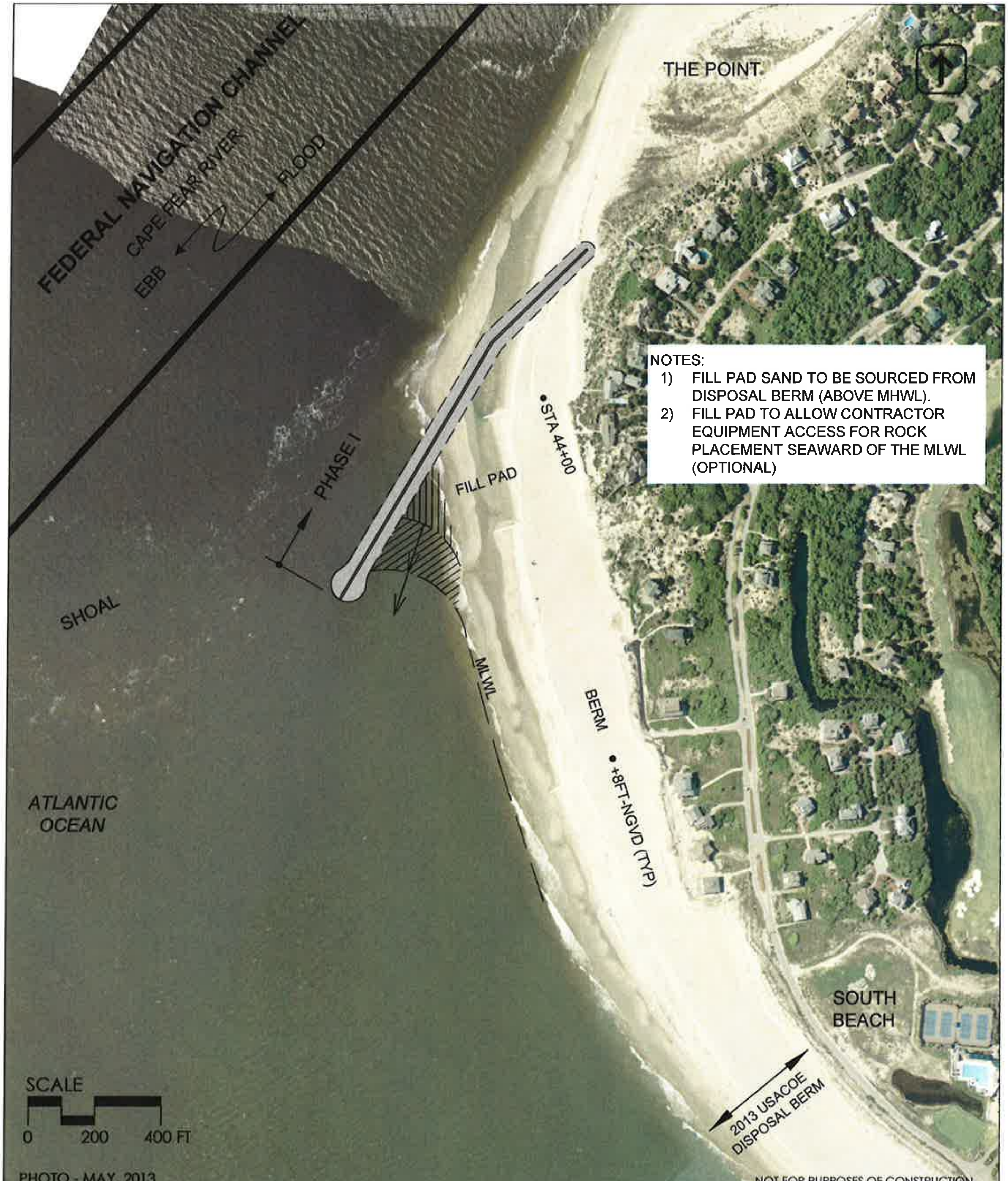
SHEET 20 of 21



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VILLAGE OF BALD HEAD ISLAND
TERMINAL GROIN PROJECT

PHASE I GROIN FILL PAD (OPTION)

DATE	APPROVED	REVISION

09/30/2013

DRAWN BY: ML

APPENDIX F

DESIGN ENGINEERING ANALYSIS FOR TERMINAL GROIN LENGTH

(Prepared by Olsen Associates, Inc.)

Potential Project Performance
Associated with Differing
Terminal Groin Length

December 6, 2012

The appropriate design length for the proposed terminal groin on Bald Head Island has been investigated through extrapolation of numerical model results and application of practical coastal engineering principles. The resulting desktop study focuses on the potential ability of different terminal groin lengths to protect varying lengths of South Beach at western Bald Head Island while minimizing negative impacts to the downdrift (west) beaches relative to a No Action alternative. For purposes of discussion, the predicted performance of three (3) terminal groin lengths is compared herein: a short groin (~1,100 feet total length), a mid-length groin (~1,900 feet total length), and a long groin (~2,900 feet total length). The landward point of attachment and general structural orientation of each groin alternative are self-similar. Each alternative is considered to be relatively permeable with respect to its ability to allow some level of sand transport over and through the structure. This is in contrast to conventional groin or jetty structures which are typically designed to be "sand-tight". The spatial extent of updrift benefits associated with a "leaky" terminal groin will be directly proportional to the length of the terminal structure. Conversely, it is expected that at some point, potentially negative downdrift impacts are also proportional to increasing structure length. A mid-length terminal groin appears to offer an acceptable balance between maintaining the updrift objective of the structure while minimizing the possibility of downdrift impacts.

The primary purpose of a terminal groin at Bald Head is to protect both private and public upland structures and infrastructure from chronic coastal erosion occurring immediately eastward of the federal navigation project. Sediment transport along western Bald Head Island is directed strongly towards the inlet, in the net. Numerical studies and physical monitoring indicate that the rate of sediment transport accelerates with proximity to the inlet. Once beach sediments reach the inlet they are either transported into the navigation channel or deposited into a large shoal formation at, or seaward of the Point. In either event these sediments are effectively lost from the littoral system on Bald Head resulting in beach profile erosion that is significant enough to warrant repeated application of erosion control measures along the affected shoreline via beach fill, placement of sand filled tube groins, and sand bag revetments.

Over the last 12 years, the shoreline orientation at the west end of Bald Head has progressively rotated clockwise to an increasing north-to-south orientation thereby resulting in increased obliqueness between the island and incident breaking waves (see **Figure 1**). This relationship is currently a significant factor in the chronically *increasing* rate of sediment transport off the island at this location. The installation of a terminal groin and beach fill are intended to strategically reorient the shoreline counter-clockwise to a more northwest-to-southeast orientation. This will decrease the effective angle between the shoreline and incident breaking waves -- thereby reducing sediment transport along the South Beach shoreline segment nearest the inlet. The resultant amount of shoreline reorientation is directly dependent upon the length of any terminal groin and its associated updrift impoundment fillet.

Along westernmost South Beach on Bald Head Island, three fundamental shoreline orientations are currently evident, A, B, and C, as presented in **Figure 1**. Shoreline orientation A, which trends north-to-south, is associated with the aforementioned highest present-day erosional segment of South Beach. Future terminal groin performance will be predicated on developing a stable westerly extension more typical of either of the two remaining shoreline orientations (B or C) throughout the chronically eroded westernmost reach – thereby essentially reversing the significant negative effects that currently exist along orientation A. Establishing some variation of either orientation B or C in the long-term, in order to decrease the strong erosional gradient existing along west Bald Head Island, requires large-scale structural stabilization – such as a terminal groin of suitable length.

It can be readily seen that a “short” groin alternative (see **Figure 2**) fails to achieve the minimum desired shoreline orientation (i.e., B). Hence its expected updrift impoundment effect does not extend throughout the most critically eroded shorefront. Instead, the westerly extension of orientation B forms the basis for defining the requisite length of the “mid-length” terminal groin (see **Figure 3**), for which the updrift effects are predicted to extend through the critically eroded area. To emulate the westerly extension of orientation C would require a significantly longer terminal structure (see **Figure 4**). The updrift effects of a “long” terminal groin would likely extend eastward through most of the existing tube groin field; however, it entails an exceptionally long structural footprint and presents much greater potential for adverse impacts to both of the inlet-facing shorelines located northward thereof (i.e., the Point and West Beach).

A calibrated Delft3D model was employed in order to predict the short- and long-term responses to construction of the proposed mid-length terminal groin. Delft3D model simulations are described under separate cover. The results suggest that the mid-length terminal groin is capable of protecting currently threatened upland infrastructure and residential structures while reducing sediment transport along western Bald Head Island to rates consistent with those computed under historic shoreline conditions -- without significant or wide-spread downdrift impacts, relative to existing conditions.

Extrapolation of the numerical modeling results for the mid-length terminal groin was employed to infer the predicted physical performance of the shorter and longer terminal groin alternatives. For example, given the small post-construction impoundment fillet supported by the short groin (**Figure 2**) this structure is expected to offer benefits akin to those afforded by the existing sand tube groins (with fill). That is, the area of direct benefit is very limited in scope and leaves several beachfront structures completely reliant upon the continued maintenance of the tube groins. Given that the Delft3D modeling of the mid-length groin suggests minimal short- and long-term downdrift impacts relative to existing conditions, it is reasonable to conclude that the increased sediment supply afforded by a shorter terminal structure would achieve similar minimal downdrift impacts. However, relative to the mid-length structure a short terminal groin would allow a greater volume of sediment to pass onto the downdrift beaches. While potentially beneficial to the downdrift beaches, this would result in a relative increase of channel shoaling and/or a shorter design life of any beach fill placed updrift of the terminal groin.

In contrast, extending the terminal groin a significant length beyond the mid-length shore normal dimension in order to maximize updrift impoundment potential (i.e., in general accordance with shoreline orientation C), would require a structure similar in length to that shown in **Figure 4**. The resulting fillet is defined by a shoreline that is nearly east-west in orientation and spans nearly the entire existing tube groin field. While theoretically possible, the resultant shoreline configuration is not typical of what would be expected at the terminal end of a barrier island for this coastline. In contrast to post-construction sediment transport rates predicted for the mid-length terminal groin, the very long terminal groin is likely to result in development of multiple updrift transport reversals including an increased potential for episodic crenulate bay formation immediately eastward of the structure. Additionally, the transport of sediment through and/or over the long terminal groin would likely occur predominantly near the structure's seaward terminus. This, combined with the overall length of the structure, suggests a decreased potential for sand to reach the downdrift shoreline, with sediment instead principally directed towards the navigation channel and/or onto Bald Head Shoal. Such a condition would be highly impactive to the Point and to West Beach.

From this investigation, it is concluded that the mid-length permeable terminal groin (on the order of 1,900 feet in total length) is the most appropriate length to reasonably and successfully achieve the objectives of decreasing erosion along the western end of South Beach and extending the longevity of placed beach fill, while minimizing impacts to the downdrift inlet shoreline and potentially reducing the rate of channel shoaling. It is noted that this effective length discussed herein is defined on the basis of the currently (2012) "eroded" shoreline location and includes a tie-back into both the existing upland and the beach fill to be constructed concurrently with structure implementation. Hence, much of the structure stem will be below grade thereby resulting in an effectively much shorter length relative to the new (post-construction) mean high water location.

Figures follow:

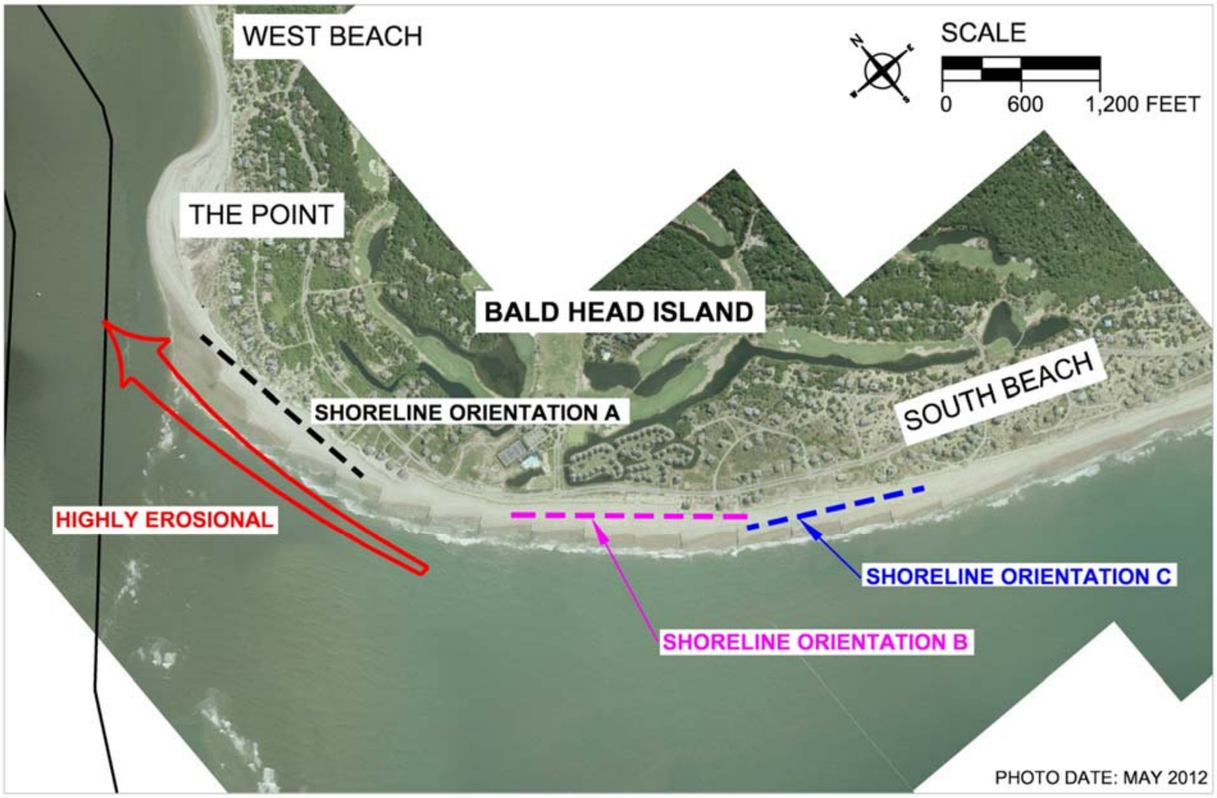

Figure 1: Fundamental shoreline orientations, A, B, and C, observed along western Bald Head Island.

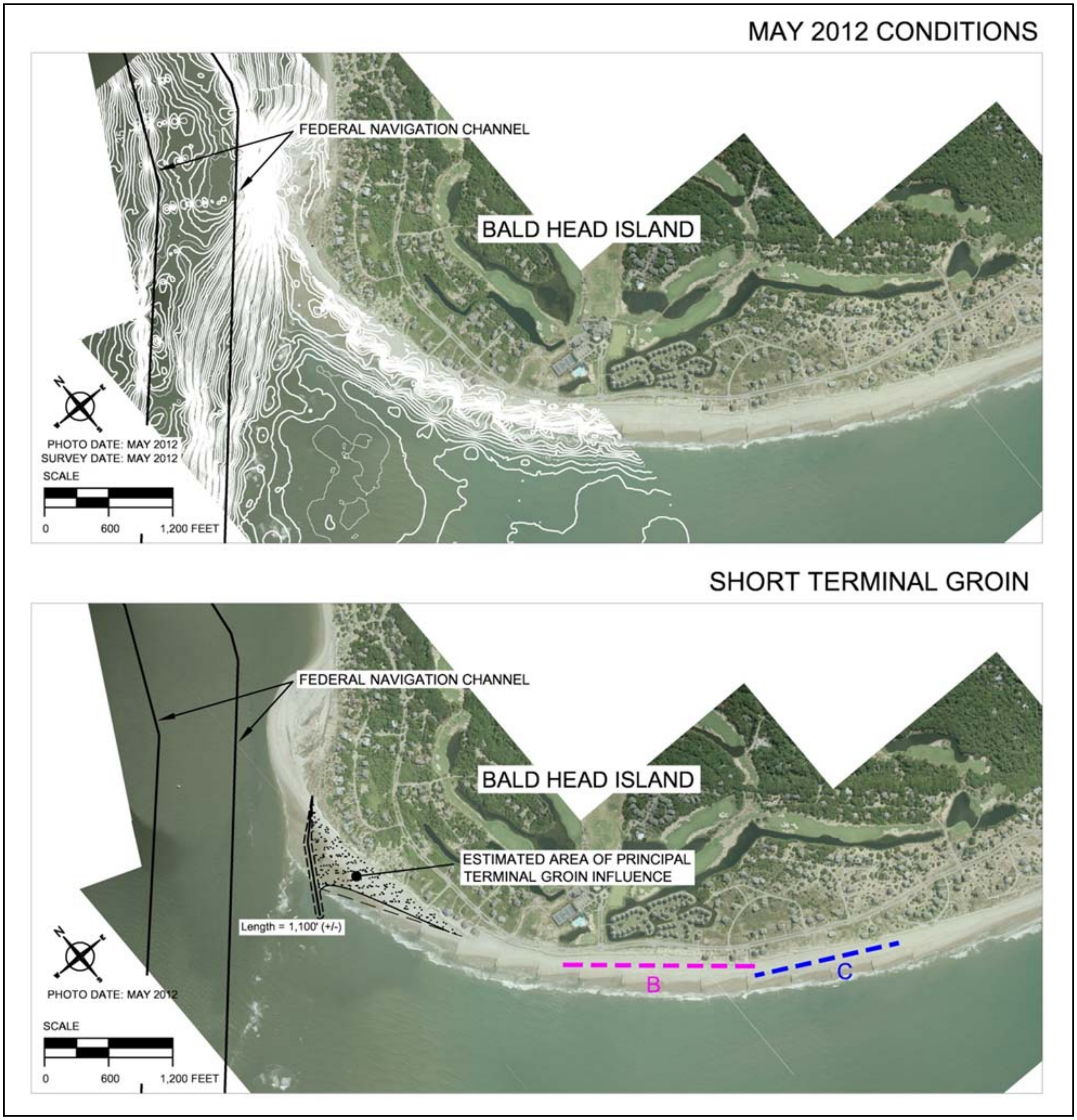

Figure 2: Conceptual illustration of updrift performance of a short terminal groin.

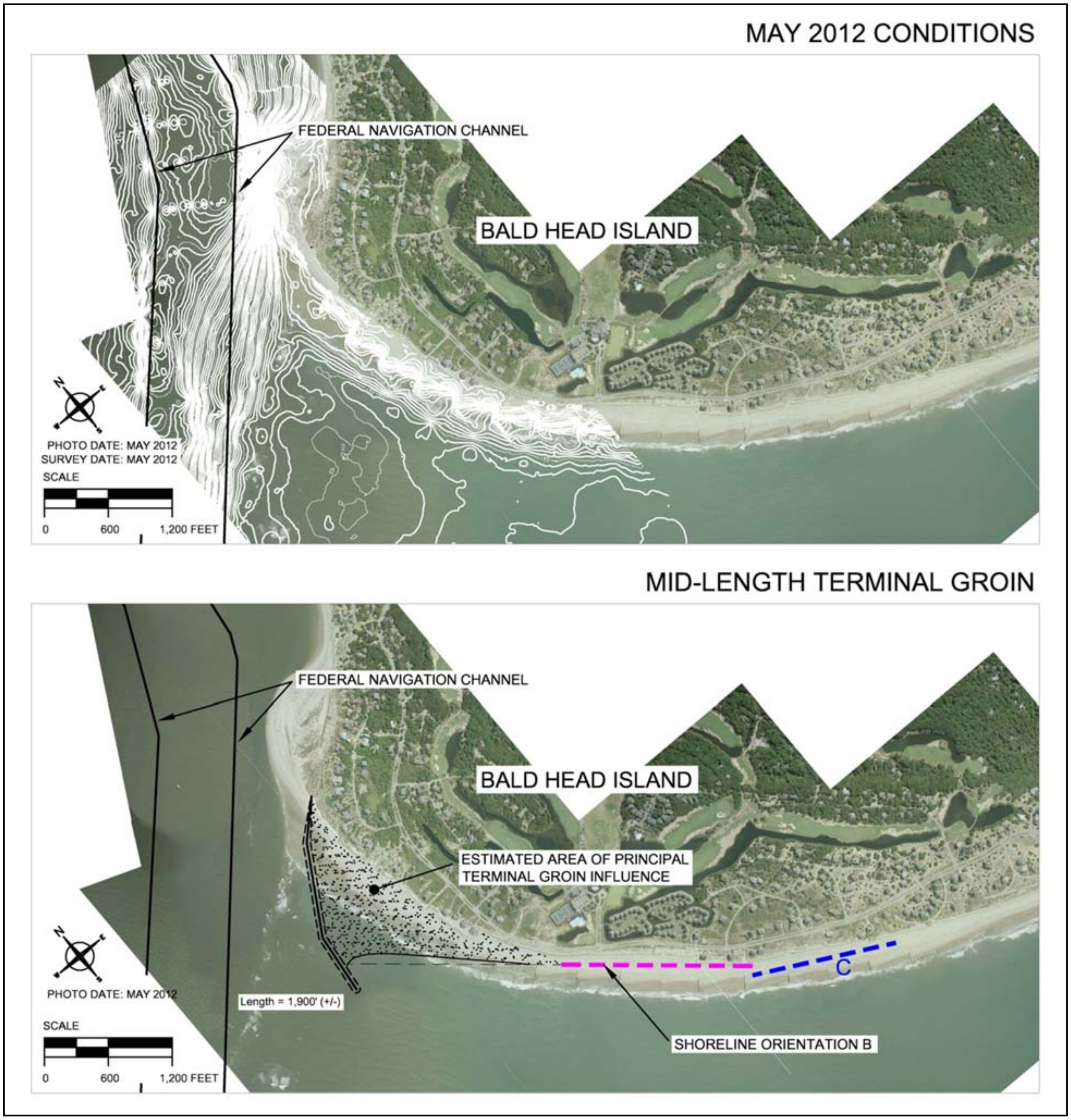

Figure 3: Conceptual illustration of updrift performance of a mid-length terminal groin.

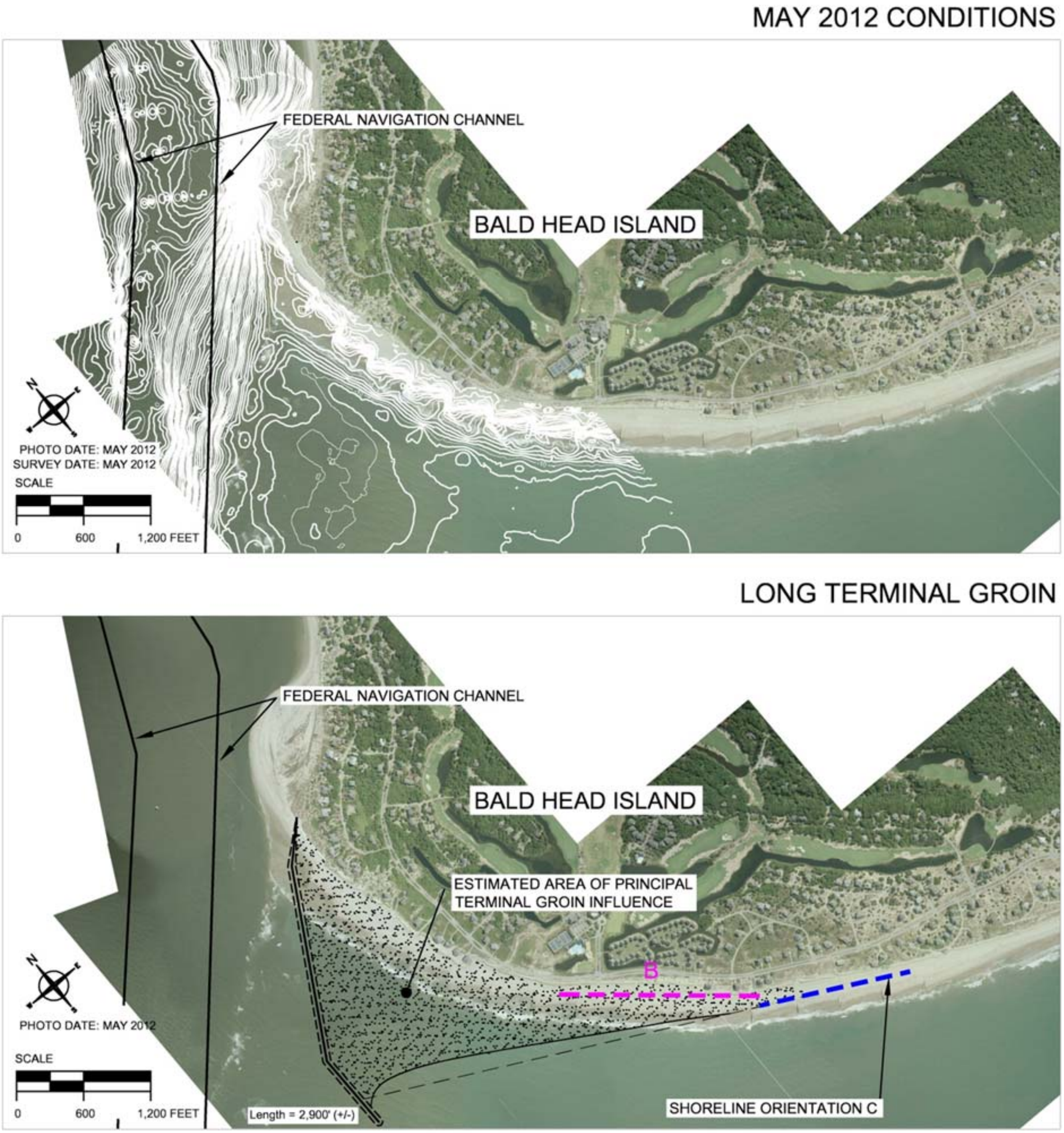

Figure 4: Conceptual illustration of updrift performance of a long terminal groin.

APPENDIX G

SOUTH AMELIA ISLAND TERMINAL GROIN – AERIAL PHOTOGRAPHS

Figure x.x: Chronology of South Amelia Island Leaky Terminal Structure constructed at Amelia Island State Park, Nassau County, Florida.

APPENDIX H

ARCHAEOLOGICAL SURVEY AND SHPO LETTER

A Phase I Remote-Sensing Archaeological Survey &
Phase II Shipwreck Assessment at the Location
Of a Proposed Terminal Groin at the
Mouth of the Cape Fear River,
Bald Head Island, Brunswick County, North Carolina

Submitted to:

Mr. Chris McCall

Shoreline Protection Manager
P. O. Box 3009
Bald Head Island, North Carolina 28461

Submitted by:

Dr. Gordon P. Watts, Jr., RPA
Principal Investigator

Tidewater Atlantic Research, Inc.
P. O. Box 2494
Washington, North Carolina 27889

6 October 2012

Abstract

Olsen Associates, Inc. (OA) is the project engineer representing the Village of Bald Head Island, North Carolina in its efforts to control erosion at the western end of Bald Head Island at the mouth of the Cape Fear River. In order to determine the effects of proposed terminal groin construction activities on potentially significant submerged cultural resources, OA contracted with Tidewater Atlantic Research, Inc. of Washington, North Carolina to conduct a magnetometer and sidescan sonar survey of the proposed construction area. Field research for the project was conducted on 24 May and 3 August 2012. Analysis of the remote-sensing data generated by the Bald Head Island survey identified a total of 104 magnetic anomalies. Four magnetic anomalies had a related acoustic signature and were determined to be associated with a shipwreck. As the wreck is potentially significant and eligible for Nomination to the National Register of Historic Places a 150-foot buffer has been established to protect the wreck. In addition, the exposed remains were subsequently investigated and mapped by archaeological divers between 2 and 5 August 2012. Documentation of the wreck remains mitigates the potential impact of sediment accretion at the site due to construction of the proposed groin. All other targets appeared to have been generated by modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, small boat anchors, boardwalks, temporary sand-filled tube groins, and a tire. No additional investigation of those sites or the wreck remains is recommended in conjunction with proposed groin construction.

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List of Figures

Introduction

The Village of Bald Head Island, North Carolina plans to construct a terminal groin at the mouth of the Cape Fear River on the western shore of Bald Head Island. In order to determine the effects of proposed construction activities on potentially significant submerged cultural resources the project engineering firm, Olsen Associates, Inc., of Jacksonville, Florida contracted with Tidewater Atlantic Research, Inc. (TAR) of Washington, North Carolina to conduct a magnetometer and sidescan sonar survey of the proposed construction area. The remote-sensing investigation conducted by TAR archaeologists was designed to provide accurate and reliable identification, assessment and documentation of submerged cultural resources in the study area. The assessment methodology was developed to comply with the criteria of the National Historic Preservation Act of 1966 (Public Law 89-665), the National Environmental Policy Act of 1969 (Public Law 11-190), Executive Order 11593, the Advisory Council on Historic Preservation Procedures for the protection of historic and cultural properties (36 CFR Part 800) and the updated guidelines described in 36 CFR 64 and 36 CFR 66. The results of the investigation were designed to furnish OA with the archaeological data required to comply with submerged cultural resource legislation and regulations.

The terrestrial portion of the remote-sensing survey was conducted around low tide on 24 May 2012, and the underwater portion around high tide on 3 August 2012. Analysis of the remote-sensing data generated during the Bald Head Island terrestrial and marine surveys identified a total of 104 magnetic anomalies. A cluster of four magnetic anomalies had related acoustic signatures clearly associated with a shipwreck. Following consultation with NCDCR personnel at Fort Fisher, the vessel was investigated by TAR archaeological divers. Between 2 and 5 August 2012, exposed sections of the surviving hull structure were documented. As the wreck is potentially significant and eligible for nomination to the National Register of Historic Places (NRHP) a 150-foot buffer has been established to protect the wreck. In addition, the exposed remains were subsequently investigated and mapped by archaeological divers between 2 and 5 August 2012. Documentation of the wreck remains mitigates the potential impact of sediment accretion at the site due to construction of the proposed groin. All other magnetic targets appear to have been generated by modern debris such as fish and crab traps, pipes, small diameter rods, cable, wire rope, chain, small boat anchors, temporary sand-filled tube groins, and a tire and are not recommended for avoidance. No additional investigation of those sites or the wreck remains is recommended in conjunction with proposed groin construction.

Project personnel consisted of Gordon P. Watts, Jr., principal investigator, John W. Morris, Joshua A. Daniel and Robin C. Arnold. Dr. Watts and archaeologist John W. Morris conducted the terrestrial portion of the survey. Dr. Watts, Mr. Daniel and Mr. Morris carried out the marine portion of the remote-sensing survey and vessel documentation. Ms. Arnold and Dr. Watts carried out the historical and literature research. Dr. Watts and Mr. Daniel analyzed the remote-sensing data. Dr. Watts, Mr. Daniel, and Ms. Arnold prepared this report.

Project Location

The remote-sensing project area is situated at the mouth of the Cape Fear River. The remote-sensing investigation area is located on the western side of Bald Head Island approximately 2,700 feet south-southwest of Bald Head Lighthouse. The area surveyed is polygonal in shape measuring approximately 2,915 feet long and 960 feet wide at its extreme points and covers an area of 46.06 acres. To ensure sufficient data would be available to locate any potentially significant targets in the project area, with the exception of an inaccessible surf zone, remote-sensing data were collected along 22 parallel lanes spaced on 50-foot intervals.

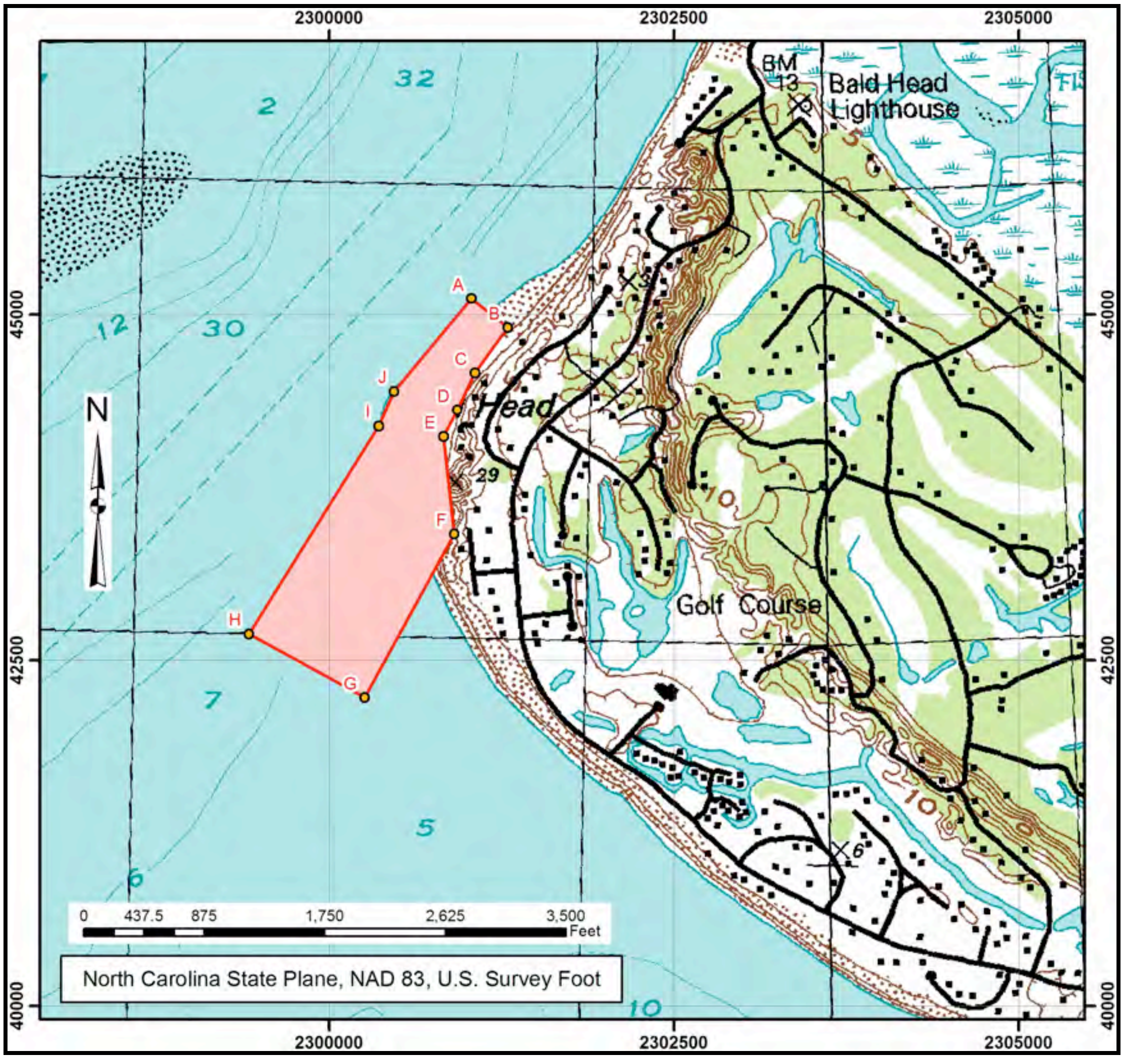

Figure 1. Project Location Map (USGS "Cape Fear, North Carolina" 1:24,000).

The survey boundaries are defined in North Carolina State Plane Coordinates, based on NAD 83, U.S. Survey Foot. Ten points define the terrestrial and marine survey areas. Geographical coordinates for those points are as follows:

Control Point	X coordinate	Y coordinate
A	2301030.1	45118.2
B	2301294.7	44907.8
C	2301054.6	44578.9
D	2300927.9	44309.3
E	2300825.7	44120.9
F	2300905.5	43413.2
G	2300255.7	42229.9
H	2299414.2	42692.0
I	2300355.1	44197.1
J	2300470.1	44446.8

Research Methodology

Literature and Historical Research

TAR historians conducted a literature search of primary and secondary sources to assess the potential to find significant historic and/or cultural resources within the proposed project site. A general background history of Bald Head Island and the lower Cape Fear region was prepared from source material in the TAR research library. Preliminary wreck-specific information was collected from sources including: *Derelicts* (Sprunt 1920), *Disasters to American Vessels, Sail and Steam, 1841-1846* (Lockhead 1954), *Encyclopedia of American Shipwrecks* (Berman 1972), *Shipwrecks of the Civil War* (Shomette 1973), *Merchant Steam Vessels of the United States 1790-1868* (Lytle and Holdcamper 1975), *Shipwrecks of the Americas* (Marx 1983), *Official Records of the Union and Confederate Navies in the War of the Rebellion* (National Historical Society 1987), *Ship Ashore!* (Mobley 1994), The Cape Fear-Northeast Cape Fear Rivers Comprehensive Study (Underwater Archaeology Unit [2 vols.] 1996), *North Carolina Shipwreck Accounts*, (Charles 2004), and *The Big Book of the Cape Fear River* (Jackson 2008). In addition, the NRHP online database (National Park Service n.d.), the Automated Wreck and Obstruction Information System (NOAA n.d.) the Northern Shipwrecks Database (Northern Maritime Research 2002), and "Lifesaving Station No. *Cape Fear*, District No. *Six*" (Gottshall [transcriber] n.d.) were queried for wreck-specific information.

Personnel at the Underwater Archaeology Branch (UAB) of the North Carolina Office of State Archaeology (Fort Fisher), the North Carolina Maritime Museum (Southport), the Brunswick County Library, and the Smith Island Museum of History were contacted for shipwreck data associated with Bald Head Island and the lower Cape Fear River.

Terrestrial Remote-Sensing Survey

The project terrestrial and inter-tidal areas were examined visually and investigated using a cesium magnetometer at low tide. Where possible, archaeologists walked the shoreline to identify evidence of vessel remains or other cultural features. Magnetic anomalies were located using GPS. A TRIMBLE GeoExplorer Series GeoXT handheld DGPS capable of +/-3 feet was employed to collect positioning data for cultural material located within the survey area. The GeoXT utilizes WAAS satellites to provide differential corrections in the field. A display shows both transects and target locations. The GeoXT was interfaced with a small PC running Hypack survey software to identify survey lanes and collect magnetometer data. A GEOMETRICS 856 cesium vapor magnetometer was used to identify buried ferromagnetic cultural material along each of the terrestrial survey lanes (Figure 2).

Figure 2. The G-856 magnetometer, Trimble DGPS and PC used for the terrestrial remote sensing survey.

Marine Remote-Sensing Survey

In order to reliably identify submerged cultural resources, TAR archaeologists conducted a systematic remote-sensing survey of the proposed groin site. Underwater survey activities were conducted from the 24-foot survey vessel *Atlantic Surveyor*, and a pedestrian survey collected data on the beach during low tide. In order to fulfill the requirements for survey activities in North Carolina, magnetic and acoustic remote-sensing equipment were employed. This combination of remote sensing represents the state of the art in submerged cultural resource location technology and offers the most reliable and cost effective method to locate and identify potentially significant targets. Data collection was controlled using a differential global positioning system (DGPS). DGPS produces the highly accurate coordinates necessary to support a sophisticated navigation program and assures reliable target location.

An EG&G GEOMETRICS G-881 marine cesium magnetometer, capable of plus or minus 0.001 gamma resolution, was employed to collect magnetic data in the survey area. To produce the most comprehensive magnetic record, data was collected at 10 samples per second. Due to shoal water within the project area, the magnetometer sensor was towed just below the water surface at a speed of approximately three to four knots. Magnetic data were recorded as a data file associated with the computer navigation system. Data from the survey were contour plotted using QUICKSURF® computer software to facilitate anomaly location and definition of target signature characteristics. All magnetic data were correlated with the acoustic remote-sensing records.

Figure 2. Launching the EG&G GEOMETRICS G-881 magnetometer.

A 445/900 kHz KLEIN SYSTEM 3900 digital sidescan sonar (interfaced with SONARPRO SONAR PROCESSING SYSTEM) was employed to collect acoustic data in the survey area (Figure 3). Due to shoal water within the project area, the sidescan sonar transducer was deployed and maintained between 3 and 5 feet below the water surface. Acoustic data were collected using a range scale of 30 and 50 meters to provide a minimum of 200% coverage and high target signature definition. Acoustic data were recorded as a digital file with SONARPRO and tied to the magnetic and positioning data by the computer navigation system.

Figure 3. Launching the KLEIN SYSTEM 3900 digital sidescan sonar.

A TRIMBLE AgGPS was used to control navigation and data collection in the survey area. That system has an accuracy of plus or minus three feet, and can be used to generate highly accurate coordinates for the computer navigation system on the survey vessel. The DGPS was employed in conjunction with an onboard laptop loaded with HYPACK navigation and data collection software (Figure 4). Positioning data generated by the navigation system were tied to magnetometer records by regular annotations to facilitate target location and anomaly analysis. All data is related to the North Carolina State Plane Coordinate System, NAD 83.

Vessel Documentation

Shipwreck remains were relocated using DGPS and sidescan sonar. Reference buoys were placed on the extremities of exposed structure to facilitate mapping and establishing the precise location of the hull remains. Archaeological divers equipped with wireless communications (Figure 5) recorded the wreck using a baseline web and measured drawings. Once buoys were moved to specific locations on the wreck remains, baseline stations A and F, and DGPS was used to establish those geographical positions.

Figure 4. Computer navigation system located at the research vessel helm.

Remote-Sensing Data Analysis

To ensure reliable target identification and assessment, analysis of the magnetic and acoustic data was carried out as it was generated. Using QUICKSURF® contouring software, magnetic data generated during the survey were contour plotted at 3-gamma intervals for analysis and accurate location of magnetic anomalies. The magnetic data was examined for anomalies, which were then isolated and analyzed in accordance with intensity, duration, areal extent and signature characteristics. Sonar records were analyzed to identify targets on the basis of configuration, areal extent, target intensity and contrast with background, elevation and shadow image, and were also reviewed for possible association with identified magnetic anomalies.

Data generated by the remote-sensing equipment were developed to support an assessment of each magnetic and acoustic signature. Analysis of each target signature included consideration of magnetic and sonar signature characteristics previously demonstrated to be reliable indicators of historically significant submerged cultural resources. Assessment of each target includes avoidance options and possible adjustments to avoid potential cultural resources. Where avoidance is not possible the assessment includes recommendations for additional investigation to determine the exact nature of the cultural material generating the signature and its potential NRHP significance. Historical evidence was developed into a background context and an inventory of shipwreck sites that identified possible correlations with magnetic targets (Appendix A). A magnetic contour map of the survey area was produced to aid in the analysis of each target.

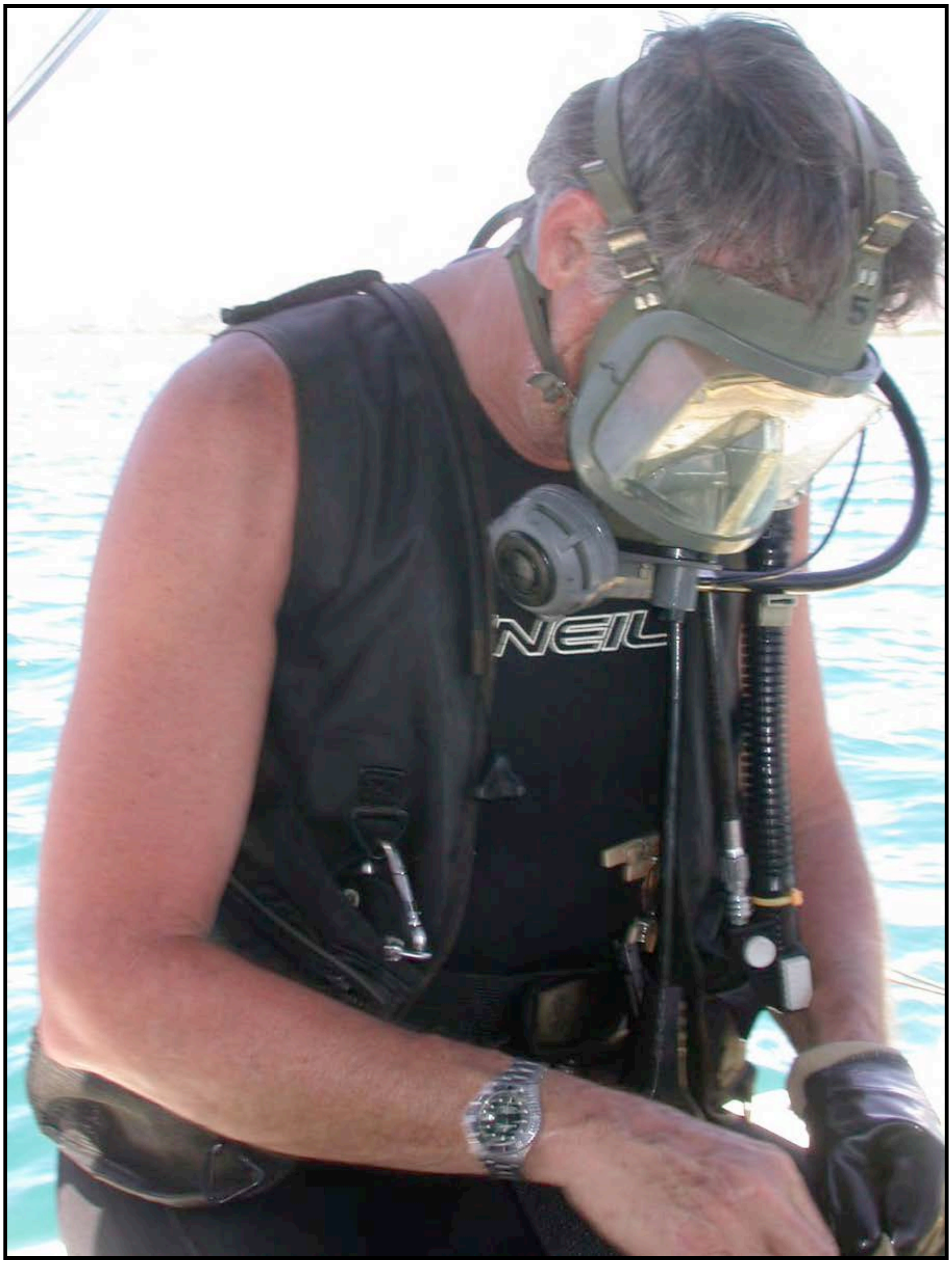

Figure 5. Diver with wireless communications mask suiting up.

Historical Background

European settlement of the present day Cape Fear region began as early as 1526 when Lucas Vásquez de Ayllón led an expedition from Florida into the Cape Fear region. One of the Spanish vessels was recorded lost near the mouth of the Cape Fear River, referred to by the Spanish as the Jordon River. During the brief existence of the Spanish settlement, the area was known as the "Land of Ayllón" (Lee 1965:3-4).

The next attempt to settle the Cape Fear region came almost a century and a half later with the arrival of the English. Settlers from the New England colonies came to the area eager to establish a Puritan colony in the less harsh climate of the south. Under the leadership of Captain William Hilton, a group arrived in the summer of 1662 to find a suitable location. Arriving at the river and "Cape Fear" as he called it, the group remained for three weeks during which time they purchased the surrounding area from the Indians. The Puritan settlers that followed during the winter of 1662 remained in the Cape Fear vicinity for only a brief time before abandoning the area (Lee 1965:4-5).

In early 1663, King Charles II granted territory south of Virginia to eight noblemen in tribute for restoring the Stuart dynasty to the monarchy. That conveyance included the area from Georgia to the Albemarle Sound region of North Carolina. The territory was divided into three counties: Albemarle [Albemarle Sound area], Clarendon [Cape Fear region] and Craven [South Carolina]. Shortly after, the Lords Proprietors received a proposal from a group of Barbadians for a settlement within the Cape Fear region. In late spring 1664, a group of 200 settlers, under the command of John Vassall, established a colony at the confluence of the Charles [modern Cape Fear] River and Town Creek (Potter 1993:5-6). The capital, Charlestown, was the first English town in Carolina (Lee 1965:5). The colony was reported to have reached a population of 800 and extended some 60 miles along the river at its zenith.

In October 1665, a second expedition by the Barbadians was launched with the intent of establishing a colony in the vicinity of Port Royal. A small fleet consisting of a frigate, sloop and a flyboat, under command of Sir John Yeamans, stopped at the Charlestown settlement after an arduous journey from Barbados. While entering the river, the flyboat, carrying the new colony's armament, ran aground on the shoals on the west side of the channel [modern Jay Bird Shoals] and was lost (Potter 1993:9, 29). The loss of this important cargo abruptly ended the Port Royal venture. Within another two years Charlestown would also be abandoned. Difficulty in obtaining supplies, differences between the proprietors and settlers over land policies and hostilities with the Natives resulted in the colony being deserted by late 1667 (Potter 1993:10-11).

In 1726, permanent settlements on the lower Cape Fear were established by South Carolina and upper North Carolina colonists (Lee 1977:7). On the west bank of the river, about 12 miles above its mouth and several miles below a shoal in the river called "the Flats," Maurice Moore established the town of Brunswick. A shoal located at the mouth of Town Creek impeded larger ships from venturing further upstream. Situated below "the Flats", Brunswick was accessible to vessels of large or small size (Lee 1977:12).

In April 1733, another community was established 15 miles upstream from Brunswick. The new settlement became known as New Town or Newton to distinguish it from the "old town" of Brunswick. In 1740, the town was incorporated and the name was changed to Wilmington (Lee 1977:12).

As hostilities with France and Spain grew during the 1740s Governor Gabriel Johnston authorized the construction of a fort along the lower Cape Fear to protect the burgeoning towns of Brunswick and Wilmington. Construction began in July 1745 on a small bluff overlooking the mouth of the river. Johnston's Fort, as it was called, was still uncompleted in 1748 when two Spanish vessels entered the river and raided Brunswick (Carson 1992:20). Efforts to finish construction intensified after the raid and in less than a year the fort was completed. The resulting structure was small and poorly constructed. It was manned by only three men and armed with four rusty cannons (Carson 1992:20). In 1751, the fort was assigned to double as a quarantine station.

Development based upon a maritime economy played a major role in the growth of both Wilmington and Brunswick during the eighteenth century. Vessels of varying size entered the Cape Fear from other coastal ports, the West Indies and Europe. Larger vessels, unable to cross over "the Flats," called at Brunswick, while vessels of smaller size could travel further up the river to Wilmington. Consequently, Brunswick was established as the center for overseas shipping and Wilmington as the center for local and West Indian trade (Lee 1977:16-17).

Rice, cattle, swine, lumber and naval stores made up the majority of the exports from the port district of Brunswick. Prior to the Revolution numerous ships left the Cape Fear River for other ports. The West Indies served as the main destination of these ships with English ports following a close second. A lesser number carried cargo to coastal ports, mostly in the northern colonies, but occasionally some ventured south, down the coast to Charleston (Lee 1977:33).

The Cape Fear region played a minor role in the events of the American Revolution. In June 1775, Royal Governor Martin fled from New Bern to Fort Johnston, then under the protection of the British man-of-war *Cruizer*. Growing patriot activity in the area forced the governor to relocate to the warship a month later. All portable materials were transferred to the ship and the fort's guns were spiked and pushed into the river (Carson 1992:22). Local forces later burned the fort and its outbuildings.

Knowing that a large number of Loyalists inhabited the interior of the colony Governor Martin initiated a plan to subjugate the region using a combination of British and Loyalist forces (Sprunt 2005:113). British reinforcements arrived off the North Carolina coast by the end of March, but by then the opportunity to subdue the colony had passed. On 27 February 1776, Colonel James Moore and the First North Carolina Continentals with a group of militia defeated a contingent of Scottish Loyalists at the battle of Moore's Creek Bridge. This battle, called the "Lexington and Concord of the south," kept the British from occupying the South at the beginning of the war (Powell 1989:180-182).

Naval operations were of limited importance in the Cape Fear region. In mid-1776, British warships began taking up regular station over the mouth of the river. In May of the following year two British men-of-war entered the river and destroyed a number of colonial vessels at anchor (Watson 1992:29). To counter the threat posed by British warships the General Assembly voted to purchase and arm three brigs for the defense of the Cape Fear River. However, these vessels proved inadequate for the task and suggestions were made for either selling them or sending them on trading or privateering expeditions (Watson 1992:29).

The lower Cape Fear remained quiet until 1781 when Major James H. Craig was dispatched by Lord Cornwallis in Charleston to take Wilmington. Craig, with a force of 18 vessels and 400 troops, quickly captured the defenseless town (Sprunt 2005:114). From Wilmington, Craig dispatched parties throughout the countryside to rally local Loyalists and to obtain supplies for Cornwallis's troops, then marching through North Carolina. After being checked by Colonial forces in the battle of Guilford Courthouse the British retreated to Wilmington to recoup and replenish supplies. Later, when Lord Cornwallis moved north to suppress Virginia, Craig remained behind in Wilmington to disrupt Colonial activity in that region. News of Cornwallis's surrender at Yorktown made the British position in Wilmington untenable and on 17 November Major Craig evacuated the city.

After the conclusion of the war there was a shift in the maritime development of the Cape Fear region. Almost all the ships that left the Cape Fear now went to Charleston and few to England or the West Indies (Lee 1977:33). Inbound ships now proceeded up to Wilmington. This shift brought about the decline of the town of Brunswick as was indicated by the change in name of the "Port of Brunswick" to the "Port of Wilmington" (Lee 1977:34).

During the last decades of the eighteenth century the area that would become the town of Southport consisted of little more than the remains of Fort Johnston and the homes of local river pilots. The region's potential, however, was realized by three men from Wilmington, Joshua Potts, John Brown and John Husk, who the viewed the area, with its salubrious sea breezes, as an ideal spot for a new town. Though the men's initial petition was rejected in 1790 the group persevered and on 15 November 1792, the General Assembly issued a charter for the establishment of a town on the bluff overlooking the mouth of the river.

The town was named Smithville, after Benjamin Smith who introduced the bill into the legislature. The town was laid out with lots offered for sale in Wilmington and Fayetteville newspapers (Figure 6). The charter specified that no person could purchase more than six lots in their name and the purchase price of lots was to be 40 shillings per lot (Carson 1992:26). The town plan also reserved space for Fort Johnston, which was rebuilt in 1804.

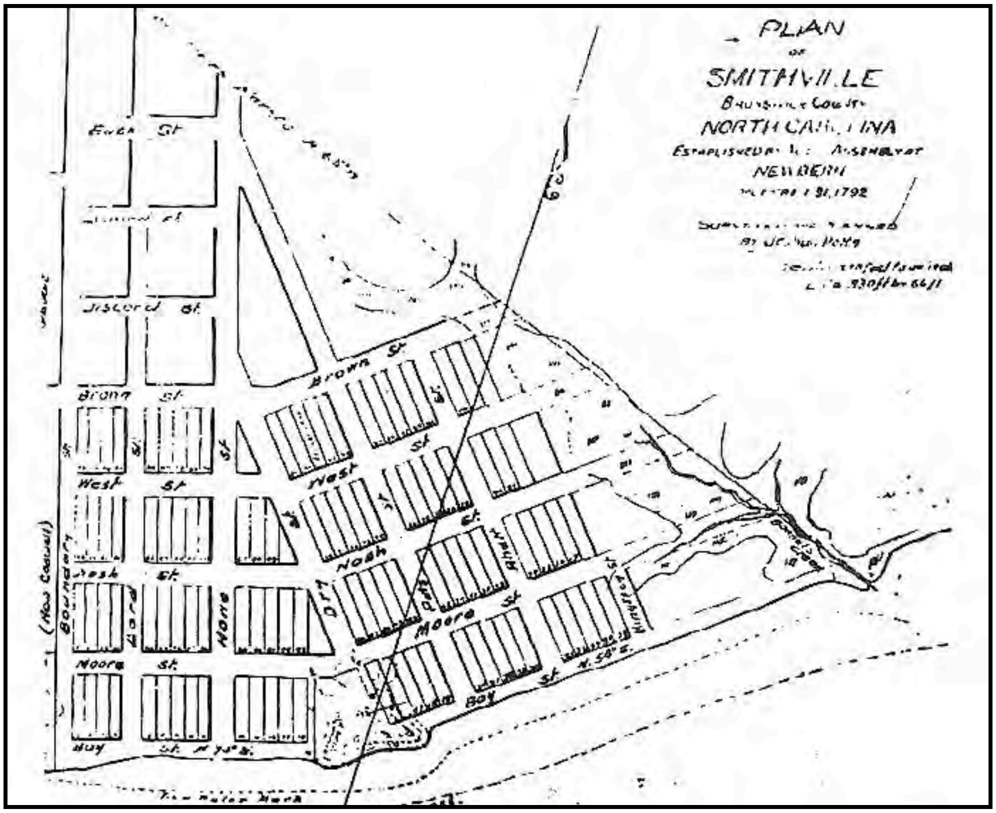

Figure 6. Plan of the town of Smithville, 1792 (Carson 1992:27).

With the growing amount of vessel traffic sailing up to Wilmington there arose a need for improvements in the navigability of the river. As early as 1784, measures were taken to improve the conditions of the lower Cape Fear River (Lee 1977:36). Improvements were needed at the treacherous entrances to the river, at the Bar and upstream at New Inlet. Three major shoals between Wilmington and the sea also caused problems for ships trying to navigate the river. The "upper shoal," located near the foot of Clarks Island, off the southern tip of Eagles Island, had eight and one-half feet of water. The "middle shoal," also known as "the Flats," had nine feet. The "lower shoal," at the foot of Campbell Island, had nine and one-half feet. The main channel of the river was then located in a narrow passage between Campbell Island, Clarks Island and the west bank (Lee 1978:112).

In addition to the shoals, ships deliberately sunk during the American Revolution as obstructions needed to be removed (Lee 1977:36-37). Around 1819, Hamilton Fulton, a noted English engineer, was hired to make improvements on the Cape Fear River mainly between Wilmington and the ocean where a system of jetties was planned. Work continued for six years until financial limitations halted this project. Some improvements were made on the river up until the start of the Civil War with sporadic financing by the state and local Wilmington businessmen (Lee 1977:37).

Steam vessels first appeared on the Cape Fear River in 1817. The first steamboat to arrive was the side-wheel *Prometheus*, built in Beaufort for a firm in Wilmington that intended to run the vessel from Wilmington to Fayetteville and Southport. The following year the Clarendon Steamboat Company was established at Wilmington. The company held the exclusive right to operate steamboats on the Cape Fear for a period of seven years provided that it kept one boat in service. In addition to the *Prometheus*, the side-wheel *Henrietta*, also made regular runs between Wilmington and Fayetteville (Lee 1977:37-38). By 1822, a second steamship venture, the Cape Fear Steamboat Company, had begun service on the river. With time the number of steamboats on the river increased significantly (Lee 1977:38).

By the 1850s, nearly a hundred vessels of all types were in Wilmington at the same time. Many of the ships were large square-rigged foreign craft, while others were side-wheel steamers. Most, however, were American schooners engaged in the coastal trade (Lee 1978:116).

Development of the Cape Fear region was soon disrupted by the Civil War. After Confederate forces in South Carolina attacked the U.S. garrison at Fort Sumter, President Abraham Lincoln declared a state of open rebellion and called for volunteers to preserve the Union. Lincoln also issued a proclamation on 19 April 1861 establishing a blockade of Confederate ports in South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas. Eight days later, Lincoln extended the blockade to include ports in Virginia and North Carolina. With North Carolina's withdrawal from the Union, Governor John W. Ellis ordered the occupations of forts Johnston and Caswell.

Union naval forces were inadequate to properly enforce the blockade at the onset of the war. In 1861, U.S. navy registers listed 90 vessels, 50 of which were propelled by sail and were considered obsolete for the task at hand. The remaining 40 were steam, but several of the deep draft vessels proved unsuitable for the shallow southern waters. Eight others were laid up while 22 vessels remained at station off foreign shores and would require at least six months travel to reach the United States (Browning 1980:24). However, within a few months of Lincoln's proclamation, Secretary of the Navy Gideon Welles took steps to implement an effective blockade off the southern coastline.

The navy department bought or leased nearly any vessel that could be of service. In nine months, U.S. Navy agents purchased 136 ships, constructed 52 and commissioned and repaired another 76 (Engle and Lott 1975:180). The Union blockade in turn gave rise to the practice of blockade running. At the beginning of the blockade, practically any vessel was considered suitable for breaking through the Atlantic squadrons to carry cargo in or out of the isolated southern ports. The most successful of the early runners were steamers that had belonged to the Southern Coasting Lines and were idle due to the outbreak of the war. The illicit trade carried on by these ships reaped considerable profit, but failed to compare with the great capital resources brought in during the latter part of the war.

Wilmington provided North Carolina with a deep-water port. By 1860, Wilmington had emerged as a modern shipping center with excellent internal communication. Three railroads ran through the city and daily steamboat service to Charleston and New York, as well as, up the Cape Fear River to Fayetteville. With the capture of New Bern, Roanoke Island and Beaufort, Wilmington was the only North Carolina port left open for the importation and exportation of goods. As long as supplies were imported through the two inlets of the Cape

Fear River and transported along the railroad lines, which connected with Lee's army in Virginia, the Confederacy had a lifeline. Wilmington soon became the most vital seaport in the "Southern Cause" (Pleasants 1979:15).

Wilmington became the key port for "runners" largely because of the area's topography. Located 28 miles from the mouth of the Cape Fear River, the port had access to the Atlantic through two separate entrances; eastward through New Inlet and southward through the river mouth (Figure 7). Although the two entrances were only six miles apart, Smith's Island, a strip of sand and shoal, lay in between. Continuing along Cape Fear were the dangerous Frying Pan Shoals, which extended 10 miles further into the Atlantic, making the distance by water between the two entrances a little less than 40 miles (Soley 1883:91).

Figure 7. Chart that depicts the two entrances into the Cape Fear River (National Historical Society 1987, I 12:38).

This geographical configuration proved highly advantageous for blockade runners and the initial blockade of Wilmington proved ineffective. When the *Daylight*, the first and at the time the only Union vessel sent to blockade these waters, arrived, it immediately experienced the difficulties associated with guarding the dual entrances of the Cape Fear River. While pursuing a steamer out of the western bar entrance, the *Daylight* inadvertently allowed several other small vessels to pass out of the New Inlet entrance. Within three months of the *Daylight's* arrival, 42 vessels either entered or cleared Wilmington (Browning 1980:27).

During a two-year period (January 1863-November 1864), Confederate naval sources listed numerous vessel stations on the Cape Fear. These vessels were identified as: the ironclad sloop *North Carolina*, the floating battery *Artic*, the steam gunboat *Yadkin*, the steam gunboat *Equator*, the torpedo boat *Squib*, and the ironclad sloop *Raleigh*, and two, long one-gun cutters. In November 1864, Confederate Secretary of the Navy Stephen Mallory also reported to President Jefferson Davis that two new torpedo boats were under construction at Wilmington (U.S. Navy [USN], 1921, ser. II, vol. 2, 1921:630,528-532, 630,743-745).

The capture of Wilmington proved difficult because both entrances to the Cape Fear were guarded by powerful fortifications and lesser works. Collectively those fortifications became known as the Lower Cape Fear Defense System. The central point of that system was Fort Fisher, located on Confederate Point. That fortification was originally a small earthworks constructed to protect New Inlet. By 1864, Fort Fisher had become the largest seacoast fortification in the Confederacy. Shaped like an inverted "L," Fort Fisher's land face ran 628 yards and was guarded by 20 of the heaviest seacoast guns. The sea face included a 130-pound Armstrong rifle and a 170-pound Blakely, both from England (Browning 1980:35). Extending from the land face was a string of torpedoes, which could be exploded from inside of the fort (Pleasants 1979:22). Mound Battery, towering to a height of 60 feet with two mounted heavy guns, stood near the end of Confederate Point. Augusta Battery, which stood behind Mound Battery, was located near the river (Pleasants 1979:24).

Fort Holmes, on the other side of New Inlet on Smith's Island, shared the protection of Smith's Inlet in the Cape Fear River with the batteries at Oak Island. Oak Island, located opposite Fort Holmes, held another series of forts and batteries, such as Fort Campbell, Fort Caswell and Battery Shaw (Pleasants 1979:24). Fort Caswell guarded the western bar entrance. Captured by Confederate militia on 14 April 1861, Caswell was renovated into a strong casemated work with new armament consisting of seven 10-inch, four 8-inch Columbiads and a 9-inch Dahlgren gun (Browning 1980:35; Pleasants 1979:24). Both Fort Caswell and Fort Holmes were responsible for shelling union vessels in the Middle Ground area, including the stranded tug *Violet*, which went aground off the Western Bar Channel on the night of 7 August 1864.

After his tug struck the shoal Ensign Thomas Stothard requested assistance from the crew of the nearby 866-ton brig USS *Vicksburg* to attempt to re-float the *Violet.* Despite their quick response, the extra manpower and effort proved fruitless as Stothard was ordered to fire the *Violet* after midnight. In response to a court of enquiry [sic] investigation, Captain Stothard submitted an incident report to Captain B.F. Sands of the USS *Fort Jackson* and offered this account:

> After all preparations for sending officers, crew, and ship's effects off in boats that he [Lieutenant-Commander Braine of the USS *Vicksburg*] and Acting Volunteer Lieutenant Williams, of the *Emma*, had sent, all of which I did, sending property, a list of which you will find enclosed, also a list of crew, I made preparations for her destruction as follows: I put a lighted slow match to a powder tank in the magazine and closed the door, then filled a large, fine drawer with shavings and straw taken from pillows and mattresses, partially covered it with another, and sprinkled two quarts of spirits of turpentine over all and on the woodwork around it; hung up an oilcloth from the table, one corner hanging in the shavings, which I touched with a lighted match (in the wardroom), after all the boats, but mine in waiting, had left the side, and I followed about 2:00 o'clock a.m. this morning. The explosion of the magazine containing about 200 pounds of powder occurred within half an hour afterwards, and by daylight she was effectually consumed. One 12-pounder was thrown overboard, one left on the forecastle, spiked with rat-tail file, and the 24-pounder was directly over the magazine aft when it exploded, so that it was thrown into the sea (National Historical Society [NHS] 1987, Ser. I, 10:343,344).

Rear-Admiral S.P. Lee recommended that no action be taken to discipline the acting officer of the *Violet*. Lee remarked to Union Secretary of the Navy Gideon Welles, that: "Stothard is a very intelligent and efficient officer, notwithstanding this casualty" (NHS 1987, Ser. I, 10:344). Prior to its destruction, the *Violet* (ex-*Martha*) was described as a fourth-rate, wooden screw steamer measuring 85 feet in length, with a beam of 19 feet. The 166-ton tug housed one, inverted, direct-acting engine with a 30-inch diameter cylinder and one return flue boiler (U.S. Navy 1921, Ser. II, 1:233).

Farther up river from the *Viole*t wreck site there were a series of forts and batteries used as secondary defenses for Wilmington and as protection for blockade runners outbound from Smith's Inlet. Fort Lamb was located on the west side of the Cape Fear River on Reeve's Point. Above Fort Lamb was Fort Anderson, the most important of the secondary defenses. Partially built from the ruins of Old Brunswick Town, Anderson consisted of a series of trenches and earthworks approximately a mile long. Three smoothbore 24-pounders, three rifled 32-pounders and six smoothbore 32-pounders comprised the Fort's armaments. By 1864, Fort Anderson had become an inspection station for all craft heading up the Cape Fear River to Wilmington (Pleasants 1979:25). Several lesser forts, including Stokes, Lee, French, Campbell, Strong and Sugarloaf, were situated on the east side of the river (Pleasants 1979:25).

In addition to this impressive array of forts, a naval construction program was initiated in Wilmington to contribute to the defenses of the harbor. The success of the ironclad ram CSS *Virginia* in the March 1862 battles at Hampton Roads demonstrated the superiority of armored warships to naval officers of both the North and South. In late March 1862, Confederate Secretary of the Navy Stephen R. Mallory, sent "instructions relative to gunboats" to Commander William T. Muse, the ranking naval officer at Wilmington. Shortly thereafter, the navy began building two ironclads in the city, the *Raleigh* at James Cassidy's shipyard at the foot of Church Street, and the *North Carolina* at the Beery shipyard on Eagle Island (Still 1985:5-17, 79-92).

Both vessels utilized a design based on plans conceived by naval constructor John L. Porter. The plans called for a tightly framed hull, with a slight deadrise and a hard chine. The vessels were to be 174 feet long (150 feet between perpendiculars) with a draft of 13 feet. Amidships, a 105-foot long casemate, angled at thirty-five degrees and covered with 4 inches of iron plate, protected the gun deck. Two boilers provided steam for the vessel's two horizontal engines, which were geared to a single 10-foot screw. The first ironclad built on this design, the CSS *Richmond*, was completed in Richmond in 1862. Known as the *Richmond* class, this group, consisting of five vessels, was numerically the largest standardized class of ironclads constructed by the Confederacy (Holcombe 1993:63-64).

The two Cape Fear ironclads entered into active service by late 1863/early 1864 (*North Carolina* in December 1863 and the *Raleigh* in April 1864) after numerous delays resulting from material shortages, strikes and epidemics. However, the usefulness of these two vessels to the Confederacy's war effort was limited. *Raleigh* grounded on a shoal near the mouth of New Inlet and was destroyed after a sortie against the blockading squadron on 7 May 1864, less than a month after entering service. The *North Carolina*, on the other hand, was reduced to serving as a floating battery; its deep draft and lack of motive power rendered the vessel ineffective as a ram.

The ironclad was further hampered by the use of unseasoned timber in its construction. Warping and splitting timbers caused the ship to leak incessantly and an infestation by teredo worms further weakened the hull. For most of its career, the ironclad remained at anchor near Smithville, positioned to support the nearby forts in the defense of Wilmington. The *North Carolina* finally sank at its moorings in September 1864. Though useless as an offensive weapon, the *North Carolina* served as a deterrent, preventing the United States Navy from entering and seizing the lower Cape Fear until the fall of Fort Fisher in the closing days of the war.

When hostilities ended in 1865 so did some of the regular river trade. The prewar steamer service between Wilmington, Charleston and Savannah was not resumed, since rail service had been established. Steamship service did, however, resume to the northern cities of Baltimore, Philadelphia and New York (Lee 1977:91). The coastal trade also revived and was conducted mainly by schooners ranging between 150 and 600 tons. Because of the decimation of American shipping during the war international commerce was carried in foreign bottoms, usually of British, German or Scandinavian origins (Sprunt 2005:501).

Industry had been severely interrupted during the war, but was beginning to make a comeback. Naval stores and lumber continued to be the principal exports with the addition of some cotton. Exports recorded for the year 1871 amounted to some 95,000 bales of cotton, 100,000 bushels of peanuts, 112,024 barrels of spirits of turpentine, 568,441 barrels of rosin, 37,867 barrels of tar and 17,963 barrels of turpentine (Sprunt 2005:513-514). Without the use of slave labor the rice industry declined dramatically (Lee 1977:86-87). By the turn of the century, a decrease in the availability of pine trees resulted in a decline of the naval stores industry. With improvements in cultivation and transportation, cotton became a major industry in Wilmington until its decline in the 1930s. Guano from the West Indies was brought in for the new fertilizer plants. The production of creosote impregnated wood also helped increase shipping in the region (Lee 1977:87-88).

During the last quarter of the nineteenth century efforts were undertaken to develop Smithville into a port city. In 1886, the North and Southern Railroad Company announced plans to extend rail service from Wilmington to Smithville. Developers, envisioning a port that would rival Charleston and Norfolk, requested that the town's name be changed to Southport to draw attention to the "Port of the South" (Carson 1992:61). In anticipation of the expected development the town's dirt roads were paved in crushed shell and the dredge boat *Woodbury* began deepening and straightening the channel to accommodate increased vessel traffic. However, the proposed rail line did not materialize and Southport remained a small town relying on fishing and tourism for its economic livelihood. The Wilmington, Brunswick and Southport Railroad eventually extended a line to the town in 1911.

Improvements to navigation on the Cape Fear River had deteriorated during the war. Continual silting reduced the navigable channel. By 1870, federally financed projects were again started to improve the conditions of the river. One such project was the closure of one of the two inlets. New Inlet was closed in 1881 with the belief that the increased force of the concentrated flow would sweep out the channel. The closure was accomplished by placing a rock dam that extended for more than a mile from Federal Point to Zeke's Island. The dam was completed in 1881 and later became known as "the Rocks." Another rock barrier was later built between Zeke's Island and Smith's Island. The channel depth was dredged to accommodate the deeper draft vessels (Lee 1977:91).

Two life-saving stations were established near the mouth of the Cape Fear River during the 1880s. Those stations included the Cape Fear station (b. 1882) at east end of Bald Head Island and the Oak Island station (b. 1889) located west of Fort Caswell. Each station was equipped with line-throwing guns and self-righting surfboats (Sprunt 2005:527). Surfmen maintained a constant vigil of the sea from the station house and conducted regular nightly beach patrols; additional patrols were conducted in daylight during stormy weather. Both stations remained active until the 1930s when new Coast Guard facilities were constructed to replace them.

A particularly severe hurricane struck the Cape Fear region during late August 1893. Originating in the Cape Verde islands, the powerful storm intensified as it passed Cuba on 26 August and shortly afterwards made landfall at Charleston. Roving bands of its destructive winds "sank or disabled five ships" in southeastern North Carolina. These maritime losses included: the schooners *Kate E. Gifford* and *Enchantress*, brig *Wustrow* (all west of Oak Island), the schooner *Jennie Thomas* (disabled south of Oak Island), and the schooner *Three Sisters* that "floundered [sic] near Bald Head Island" (Mobley 1994:117). Local lifesaving station keepers Dunbar Davis [Oak Island] and J. L. Watts [Cape Fear] cooperated with volunteer surfmen who "exhaustively went from wreck to wreck utilizing breeches buoy, surfboat[s], a team of oxen, and sheer fortitude to render assistance to the disaster victims" (Mobley 1994:117).

In the aftermath of the hurricane, several derelicts were towed into Southport after 29 August and well into September 1893. According to a Federal report, the American three-masted schooner *Three Sisters* was first among the number (U.S. Hydrographic Office [USHO] 1894:13, 17; U.S. Treasury Department 1895:). On 1 September, the Norwegian bark *Linda* was towed to Southport by the British steamship *Eric*. The tug *Blanche* reportedly towed an unknown potential hurricane casualty to the port on 7 September. On the following day, the tug *Alexander Jones* towed the American three-masted schooner *William Smith* to Southport. Another schooner of the same type [identity unknown] was also towed there on 21 September 1893. On 17 October, the *Julia A. Trubee* was towed to Southport by an unknown vessel. In this instance, the cause of the American three-masted schooner abandonment was not recorded (USHO 1894:13, 17).

On 20 July 1895, the U.S. Marine Hospital Service appropriated $25,000 for the construction of a quarantine station at Southport. The new station was to be located on the river on the east side of the channel between the upper end of Battery Island and Price's Creek Lighthouse (Carson 1992:73). The entire station was to be built on a pier 600 feet long and to consist of a hospital building, a disinfecting house, attendant's quarters and a kitchen. The station opened for service by the middle of 1897 with Dr. J. M. Eager appointed as the station's first quarantine officer. A report for the fiscal year 1907 illustrates the level of activity at the station:

> [Eighty six] vessels spoken and passed; 19 steamers and 1 sailing vessels inspected and passed; 2 steamers and 3 sailing vessels disinfected; and 485 crew on steamers, 125 crew on sailing vessels, and 3 passengers on sailing vessels inspected. The vessels disinfected were from Bahia, Portobello, Santos, Rios, and Barbados (Brown 1974).

By 1937 the station had become obsolete and was placed on caretaker status. As the facility was located on water and not a navigation hazard it was left to deteriorate and on 19 August 1951, the abandoned station was destroyed by fire (Brown 1974).

The fishing industry provided the financial stamina for the economy on the lower Cape Fear during the early years of the twentieth century. The principal source of income for Southport was the menhaden fisheries. Most catches were processed into oil, which was used in the manufacture of paints, linoleum, tanning solutions, soaps and waterproof fabrics (Carson 1992:96). Leftover scrap was ground up for fertilizer and feed for livestock. The Southport Fish Scrap and Oil Company and the Brunswick Navigation Company established processing plants along the Elizabeth River while additional plants could be found above the town on the Cape Fear River.

World War I initiated a revitalization of the economy with the establishment of the Carolina Shipyard in May 1918. At about the same time, the Liberty Shipyard started producing steel ships as well as experimental concrete ships. The success of the shipyards was short-lived and the economy fluctuated for several years until it fell during the 1930s. Though Wilmington saw moderate success in shipping and shipbuilding after the war, most of the yards had closed by the mid-1920s and competition from Norfolk and Charleston slowly relegated the city to an import distribution center catering mainly to regional trade (Watson 1992:145).

This trade averaged 200,000 or more tons through most of the 1920s, but with the coming of the Great Depression, the amount fell to 94,007 tons by 1932 (Watson 1992:150). Wilmington's economy would not fully recover from the effects of the depression until the end of the decade. Despite this economic uncertainty, foundations were laid for future development. By the beginning of World War II, Wilmington boasted 54 wharves, piers and docks and the opening of the Atlantic Intracoastal Waterway expanded the city's trade with its hinterland and increased its role in the coastal trade (Watson 1992:148-9).

With war in Europe and German submarines prowling the east coast during the early 1940s protection and defense of the coast became a top priority in Washington. The vulnerability of the Cape Fear had been confirmed during World War I and U.S. Navy officials were anxious to be prepared for future enemy intrusions (Gannon 1990:242-243). On 17 November 1941, the U.S. Navy reacquired the 248.8-acre Fort Caswell reservation, sold into private hands in 1929. The old fort grounds were to be used for training, communications and submarine tracking (Carson 1992:126).

The U-boat threat finally reached the Cape Fear region in early 1942. On 16 March, the 11,641-ton tanker *John D. Gill* was torpedoed in the coastal waters off the mouth of the river. As a result of the high number of vessel losses during the early stages of the war, defensive measures were put into place. Coastal communities were systematically blacked out, a more efficient convoy system was devised and additional planes and patrol vessels were put into service along the North Carolina coast (Stick 1952:237-239).

In addition to the menace that Axis submarines and aircraft represented during the conflict, a significant hurricane struck the project area in late summer 1944. On 1 August, the tropical storm made landfall near Southport and the Oak Island coast guard station reported maximum wind speeds of 80 miles per hour. To the north, "substantial damage" occurred in Wilmington and Wrightsville Beach and the combined losses of real estate and crops amounted to two million dollars (Galecki 2005:133-134).

World War II also brought renewed growth to the shipyards and relief to the area (Lee 1977:88-90). The increased jobs and higher wages allowed Wilmington's economy to increase and become stable. After the war many of the people brought in to build ships chose to stay and make Wilmington their home. In 1945, the State Port Authority was formed, promoting ports in Wilmington and Morehead City and creating new jobs. In 1955, the military established the Sunny Point Army Terminal [Military Ocean Terminal at Sunny Point]. The facility serves as a terminal for shipping military hardware and ammunition to American forces around the globe. The base is a major employer in the area and local service and retail industries serving the military contribute to the economic prosperity of the region. By 1960, the population of Southport was reported as 2,034 residents. At that time, the town boasted a popular bookmobile, a new water tank, a "lighted" athletic field and a picnic area at the community park. Maritime news included the launch of a "big, new charter boat," the *Riptide*. Herman Sellers constructed the vessel for Glenn Trunnell of Southport. Other local commercial fishermen commenced discussions on the merits to install an artificial reef near the town. In September 1960, Hurricane *Donna* struck the region and fortunately caused only minimal damage in Brunswick County (Reaves 1999:169,172).

In early February 1970, the Atomic Energy Commission approved construction of a 385 million dollar nuclear power plant to be situated north of Southport. The downtown also experienced a significant economic boost when First-Citizens elected to build a bank in Southport, its first branch in Brunswick County. At the same time, waterfront interests offered services to the public such as the modern 150-seat restaurant Herman's and the new 450-foot long "fishing and pleasure pier" (Reaves 1999:243).

Today, the region presents a strong economy with a state port facility that is daily frequented by international cargo vessels. The economy is further augmented by the military and commercial fisheries, which provide an important source of income to area residents. In addition, Southport and the coastal communities on Oak Island and the resort on Bald Head Island are popular tourist destinations. The area's offshore waters are a sportsman's paradise catering to recreational boaters and sport fishermen alike.

Improvement History of the Entrance Channel to the Cape Fear River

In 1870, the U.S. Army Corps of Engineers (USACE) initiated a project to improve navigation on the Cape Fear River. An examination of the river conducted by a commission appointed by the War Department suggested that priorities at that time should be given to closing off the channel between Smith's and Zeke's Islands (U.S. Army Corps of Engineers [USACE] 1870:70). In 1874, the closing off of New Inlet had increased the flow of water in the main navigation channel and scouring effects were noted to be deepening the channel over Bald Head Bar (USACE 1874:88-89). The officer in charge of operations also stated that a suction dredge was employed at Bald Head Bar to assist in the scouring process. Furthermore, the officer's report also noted that there were two channels into the river: a western channel with two bars (an outer with 14 feet at low water and an inner or "rip" with 10 feet at low water) and the Bald Head channel (USACE 1874:69). It was suggested that since the Bald Head channel was the natural channel all efforts should be directed towards maintaining a 12-foot level of water over it and that the western channel be disregarded.

In 1889, the project was modified to provide for a 20-foot depth, at low water, from Wilmington to the Ocean. Surveys conducted during the fiscal year ending 30 June 1890 reported that the depth of water over bar had reached 16 feet (USACE 1890:131). The wreck of a Civil War gunboat was uncovered during dredging activities on the bar in 1891. The boiler from the wreck reduced water depths in the channel to 13.5 feet providing a serious impediment to navigation (*The Messenger* [*TM*] 16 May 1891). Examinations of the wreck indicated that it was a wooden-hull vessel approximately 110 tons and 100 to 110 feet long (USACE 1893; Appendix L:1451). Portions of the flue and the boiler were removed by agents of the Federal government in 1890. On 20 May 1893, Messrs. Johnston and Townsend were awarded a contract to remove the rest of the wreck structure (USACE 1893, Appendix L:1451). The wreck site was dynamited and remaining sections of boiler recovered for disposal. Inspections of the wreck area by First Lieutenant E. W. Lucas, E. D. Thompson and Robert Merritt revealed no trace of the hull and soundings in the vicinity indicated a depth of water of 22 feet (*TM* 7 July 1893; USACE 1893, Appendix L:1451).

The River and Harbor Act of 2 March 1907 provided for additional dredging for completing the channel to the mandated 20-foot depth level. In addition, the Act also authorized for improvements in excess of 20 feet as appropriations permitted (USACE 1912:459). The project was modified again in the River and Harbor Act of 25 July 1912. Those modifications called for a channel of 26 feet deep at low water with widths of 300 feet in the river, increasing to 400 feet across the bar and in curves in the river (USACE 1912:459-460). The controlling depths of the channel were increased to 30 feet in the River and Harbor Act of 2 March 1919. In 1922, the USACE discontinued the contemporary current entrance channel and authorized for a new one over the bar with the same dimensions as the previous one (USACE 1922:682-683). The new channel was to run in a southwesterly direction from Bald Head Point. These improvements were noted as being completed in 1932.

In the River and Harbor Act of 2 March 1945, the controlling dimensions for the navigation channels on the Cape Fear River were increased further. Water depths from the outer end of the bar to Wilmington were increased to 32 feet and all channels were now to maintain a width of 400 feet throughout (USACE 1945:632-631). The project was estimated to be 65 per cent complete by the end of the fiscal year. In 1950, the controlling depths over the ocean bar were increased to 35 feet (USACE 1950:653-654). Additional modifications to the navigation channels were authorized in the River and Harbor Act of 23 October 1962. Among the provisions of that Act was the deepening and widening of the entrance channel to 40 feet deep and 500 feet wide (USACE 1962:360-361). The channel was to maintain those dimensions as far as Southport were they were reduced to 38 feet deep and 400 feet wide up to Wilmington. The project was reported as being completed in 1973 (USACE 1979:6-9).

Description of Findings

The remote-sensing survey of the Bald Head Island investigation area identified a total of 104 magnetic anomalies and two acoustic targets (Figure 8).

None of the terrestrial anomalies were determined to have signature characteristics suggestive of potentially significant cultural resources. All were associated with modern construction features such as walkways, sand bags or modern debris visible on the ground surface. With the exception of a four anomalies, none of the marine magnetic signatures were determined to have characteristics suggestive of potentially significant cultural resources.

That cluster of four magnetic anomalies (86, 89, 90, and 93) (Appendix B) was associated with acoustic signatures (Appendix C) created by a shipwreck (Figures 9 and 10). One additional acoustic target and one associated magnetic signature (103) were generated by a vehicle tire. No additional investigation of this target is recommended.

Shipwreck Documentation

After consultation with UAB personnel at Fort Fisher, a Phase II investigation of the shipwreck site was determined to be necessary. Archaeological diver investigation of material generating the shipwreck signatures confirmed that the site was indeed the remains of a vessel. The surviving hull remains were found in three basic sections that include: a fragment of the bow, a large section of the lower hull, and a section of the stern (Figure 11).

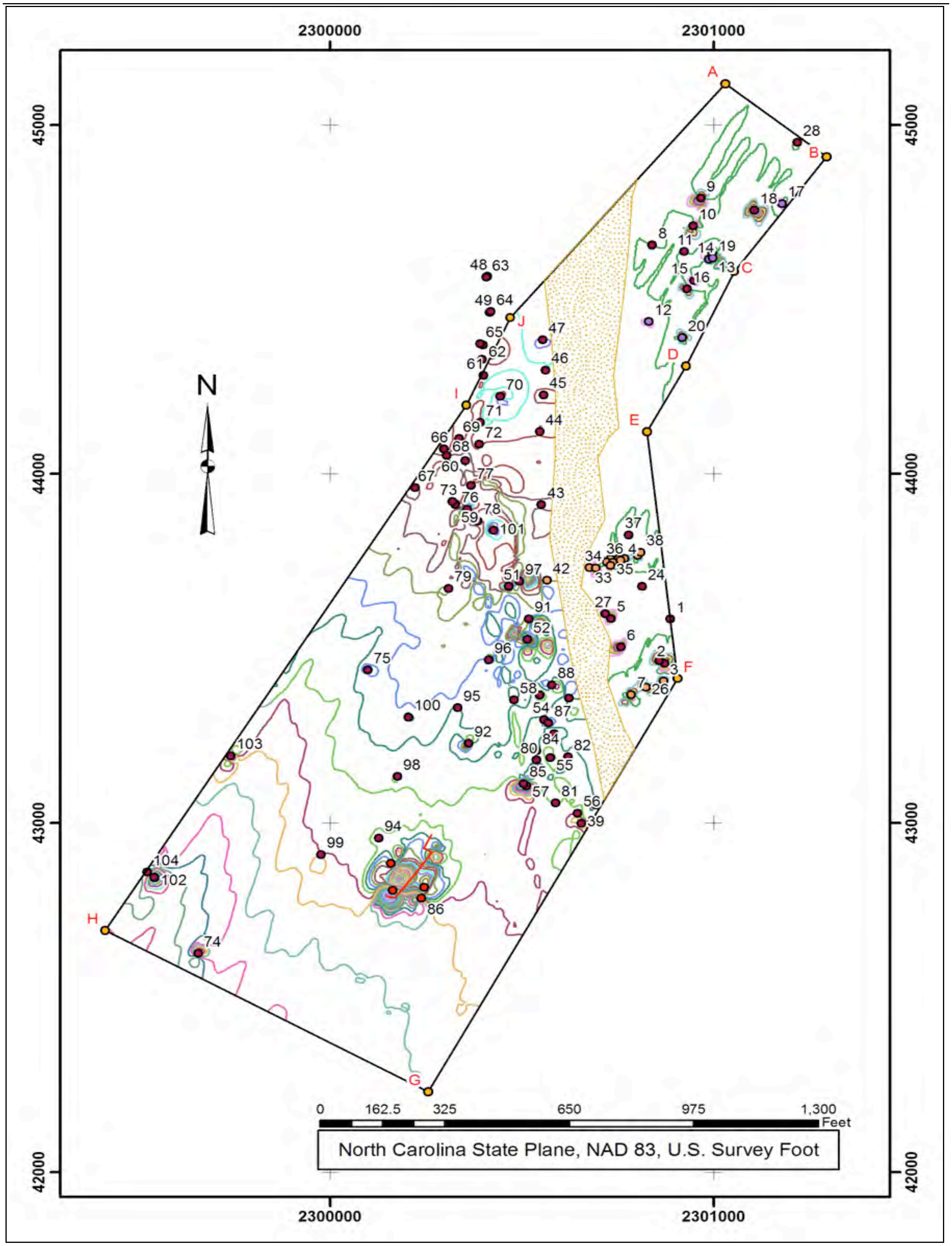

Figure 8. Magnetic contour map with anomalies.

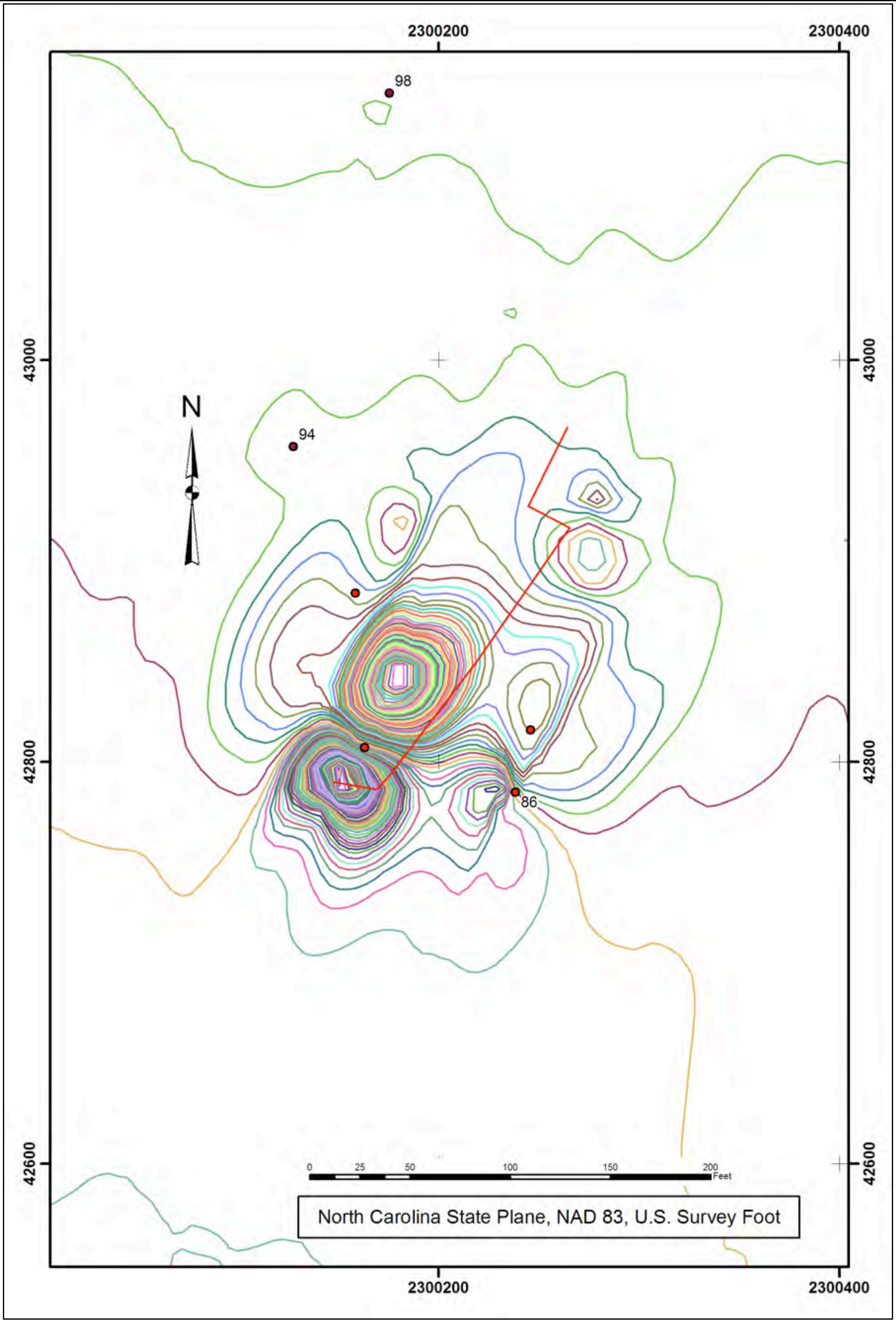

Figure 9. Shipwreck magnetic anomaly with shipwreck baseline.

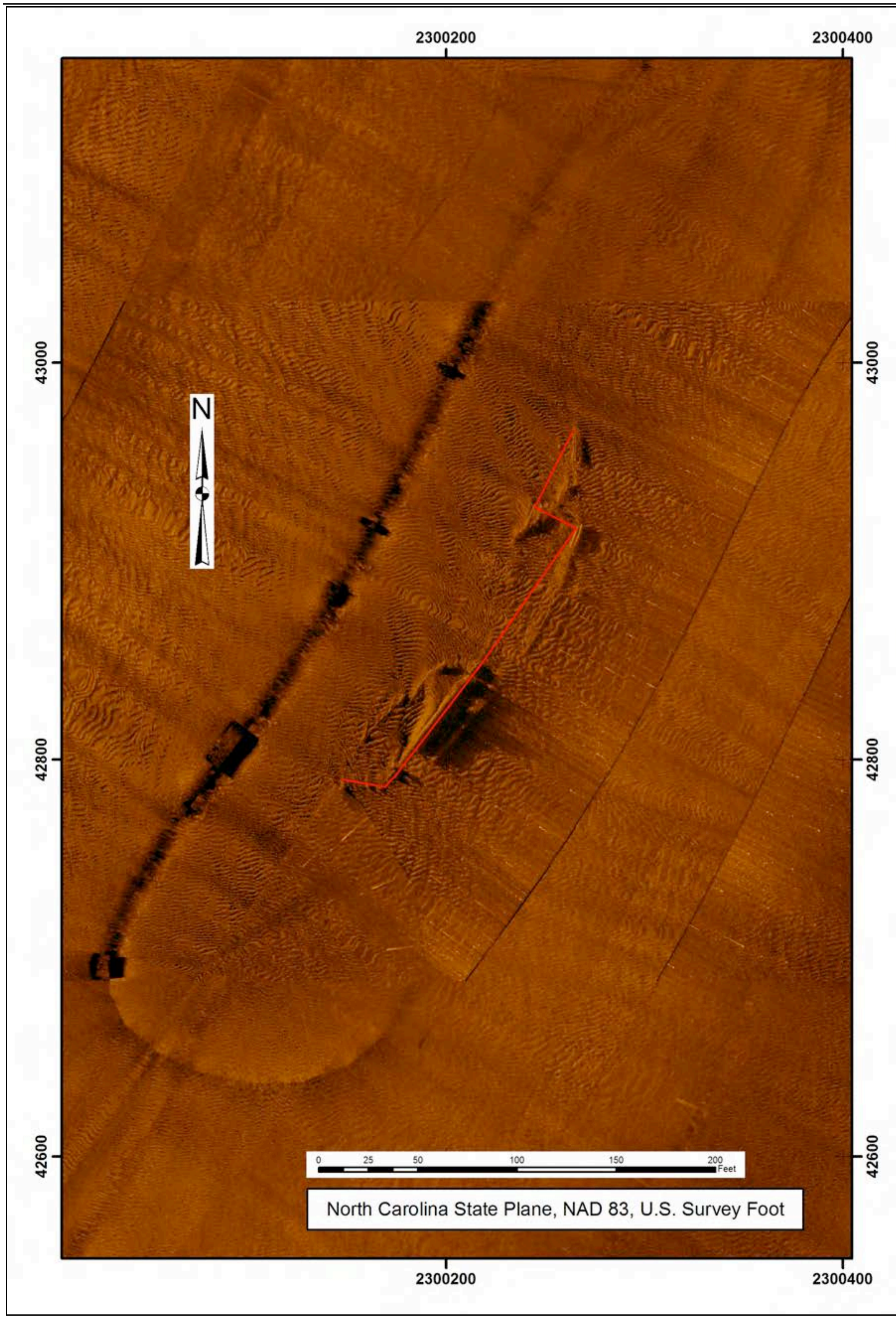

Figure 10. Shipwreck sonar image with baseline.

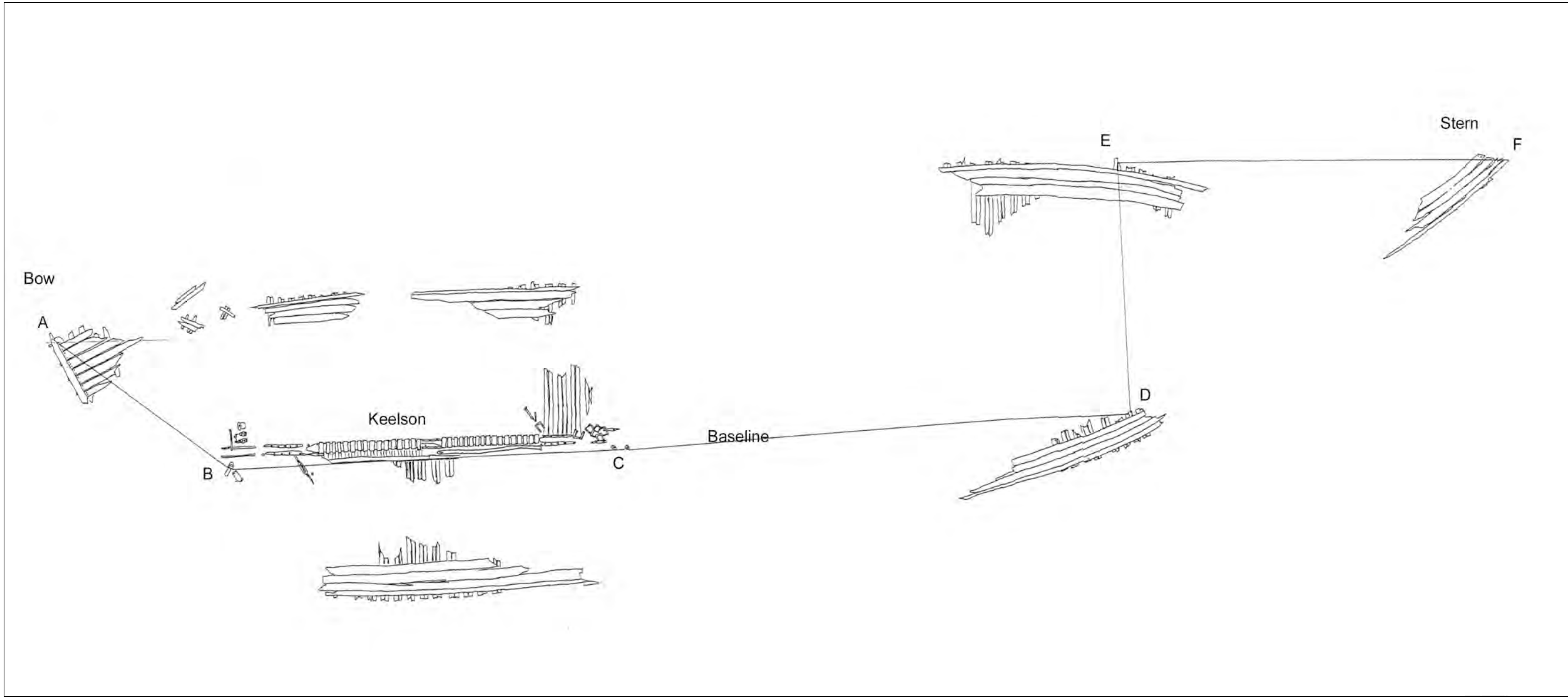

Figure 11. Plan of exposed wreck remains.

Remains of the bow lay southwest of the largest section of hull remains. It consisted of an eight-foot section of the stem, inner stem, port cant frames, exterior planking and a cast-iron hawse pipe. Due to deterioration, the exact dimensions of the cant frames and planking could not be determined. The stem section measured 5 inches across the face and 12 inches fore and aft. The aft face and measurements for the inner stem were inaccessible.

The largest section of remains was the lower hull. That section of exposed hull was approximately 48 feet in length and 32 feet in width. It consists of the keel, keelson, reinforcing iron straps on the keelson, floors, futtocks, ceiling strakes and bilge wales. The keelson was only exposed at the forward end of the hull section and measured 12 inches sided and 20 inches moulded. Two 11-foot, 6-inch sections of the keelson were reinforced by “U” shaped wrought iron straps. The straps measured 6 inches in width, 2 inches in thickness and were installed every 3 inches. Each strap was 17 inches in length and 15 inches across the base of the “U” (Figure 12). A cluster of the wrought iron straps was located aft of those that remained attached to the keelson. No evidence of mast steps was found on the surviving remains of the keelson.

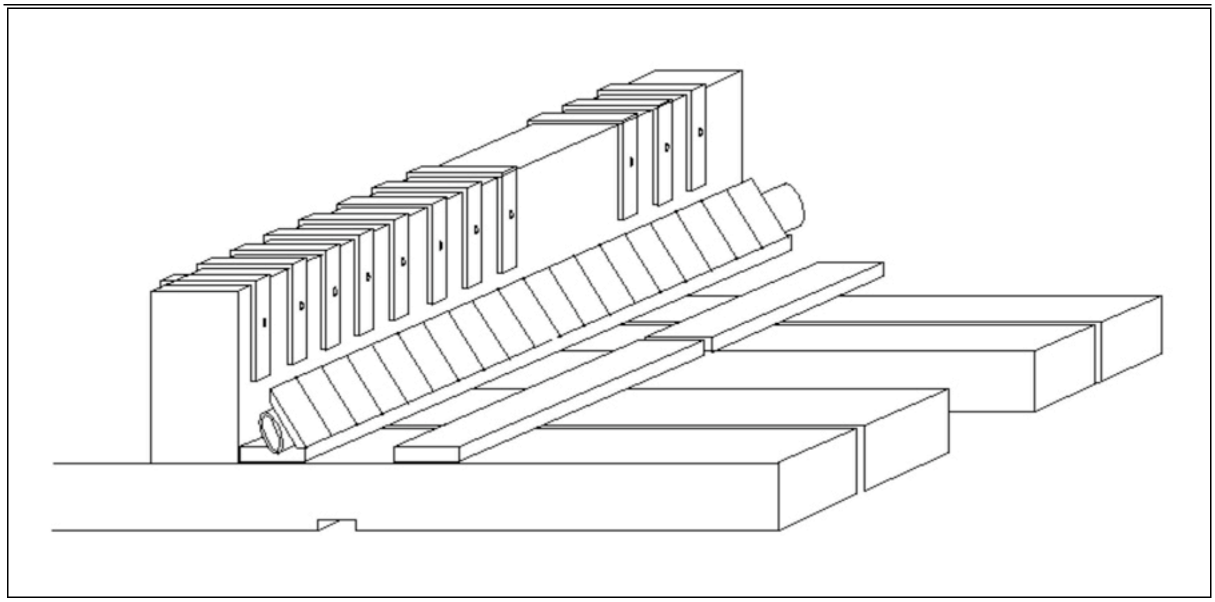

Figure 12. Illustration of the keelson configuration.

The floors immediately outboard of the keel/keelson measured 9 inches sided and 12 inches moulded. At the turn of the bilge the futtocks measured 9 inches sided and 8 inches moulded. Space measured at 10 inches. All of the examined floors and futtocks were oak. Two inboard ceiling planks were exposed on the port side and both measured 12 inches wide and 3 inches thick. At the turn of the bilge a composite wale covered the compass timber. The bilge wales on both sides of the hull were composed of three 12-inch sided by 10-inch moulded timbers. The size of a fourth wale timber could not be determined due to deterioration but appeared to be fashioned to make the turn of the bilge. Hull planking was 11 to 12 inches wide and 2.5 inches at the turn of the bilge.

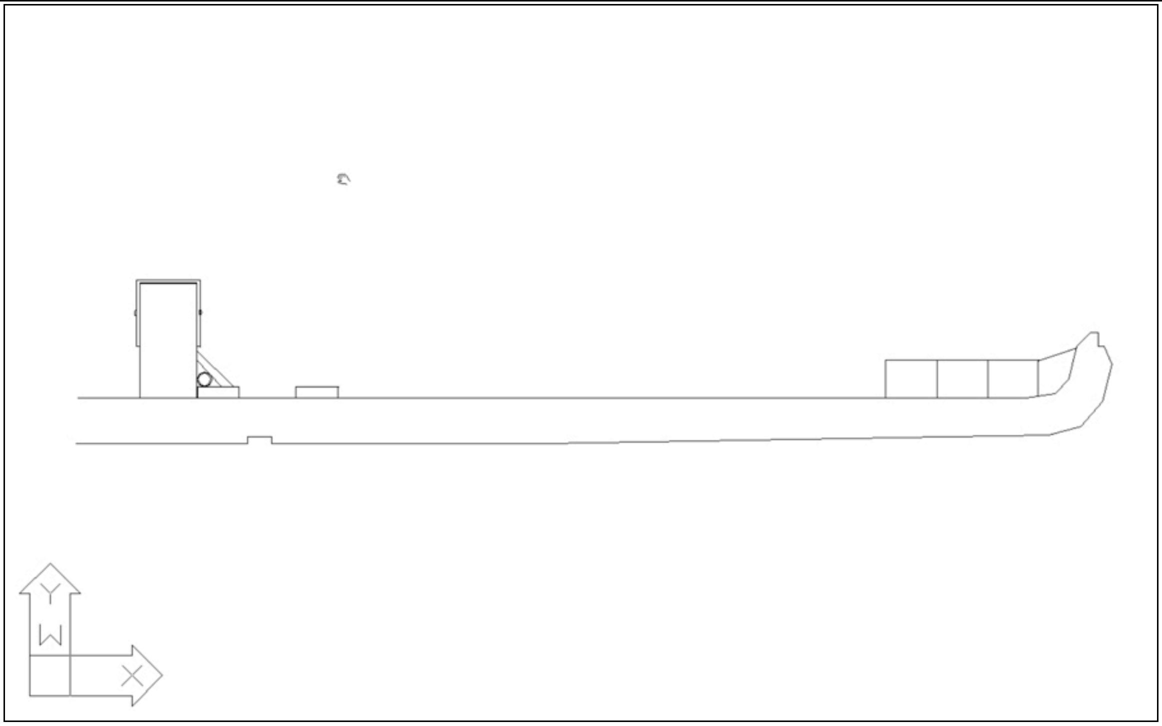

Figure 13. Cross section of the port side of the hull approximately midships (looking aft).

An iron pipe approximately 5 inches in diameter was attached longitudinally to the port base of the keelson and was protected by covering boards. It terminated near the forward end of intact keelson structure. Near that point off the starboard side of the keelson, the remains of what appeared to be a heavily concreted Worthington steam pump was found. Immediately outboard of the pump, what appears to be a steam cylinder was partially exposed. On the port side of the keelson, immediately aft of the pump and cylinder, a second hawse pipe and two other iron pipes were found (Figure 11 at Station B).

A fragment of lower hull in the stern was found off the north end of the main section of wreckage. That section of hull measured approximately 30 feet in length. That portion did not contain the remains of the keelson and the bilge wales were approximately 10 to 12 feet outboard of the location of the keel/keelson. No evidence of the stern deadwood or sternpost was identified in the area.

Conclusions and Recommendations

A survey of historical and archaeological literature and background research confirmed evidence of sustained historical maritime activity associated with Bald Head Island and the Cape Fear River area that continues to the contemporary date. Documented transportation activities in the vicinity of Bald Head Island and neighboring waterways date from the first half of the sixteenth century. The Cape Fear River region became a focus for European activities as early as 1526 when Lucas Vásquez de Ayllón led an expedition from Florida into the Cape Fear region. Permanent settlement along the banks of the Cape Fear River began during the second decade of the eighteenth century.

As a consequence of nearly 400 years of navigation in the coastal region of Brunswick County and settlement along the banks of the Cape Fear River since the eighteenth century, there is a high probability that historically significant submerged cultural resources are located in the area. While no shipwrecks in the project vicinity have been listed on the NRHP or with the UAB, previously identified vessel remains document that they exist; as there are at least 27 shipwrecks recorded in the coastal waters near Bald Head Island and the mouth of the Cape Fear River (Appendix A). Because of their association with the broad patterns of North Carolina history, the remains of sunken vessels preserve important information about the maritime heritage of the North Carolina coast.

Remote sensing of the terrestrial survey area identified 104 magnetic anomalies. However, none of those magnetic anomalies are considered to be associated with potentially significant cultural resources. No additional investigation of that area is recommended in conjunction with the currently proposed project. The marine remote-sensing survey identified 104 magnetic and two acoustic targets. Two of the magnetic anomalies and the corresponding sonar images were determined to be generated by the remains of a vessel. That site was recommended for additional investigation. Archaeological diver reconnaissance of the wreck confirmed that it consisted of fragments of a large wood hull vessel.

The wreck remains appear to be those of a vessel approximately 160 to 190 feet in length. As no evidence of steam propulsion was discovered, it appears that the ship was a sailing vessel. The most likely candidates appear to be a large schooner or possibly a ship or bark rigged cargo vessel. The steam pump and cylinder appear to most likely represent machinery for dewatering, firefighting and/or power for a steam windlass or capstan for sail and/or cargo handling or ground tackle.

An accurate estimate of tonnage is impossible based on the available data. However, a reasonable range could vary from about 460 to approximately 700 tons using the formula: estimated length times estimated beam times estimated depth of hold divided by 100. Historical research indicates that at least three vessels could be candidates for association with the wreck remains. The largest of those vessels is the 704-ton schooner barge *Virginia* that foundered in 1906. The smallest is the 404-ton bark *Aphid* wrecked on Ella Shoal in 1893. Perhaps the most-likely candidate is the 639-ton schooner *Charles H. Valentine* wrecked off Bald Head Point on Smith Island in 1911.

Because the wreck is located within 70 feet of the initially proposed groin location (Figure 14) a shift in the construction alignment is recommended to provide a minimum of 150 feet of clearance (Figure 15). As the groin is designed to cause sand to accrete along the southwestern shoreline of Bald Head Point, the wreck remains will likely be covered with several feet of sediment. That sediment will afford protection for the surviving hull remains. Because a preliminary plan for the exposed hull structure has been developed and details of design and construction recorded, burial of the remains will be a positive impact on the site and no additional investigation is recommended.

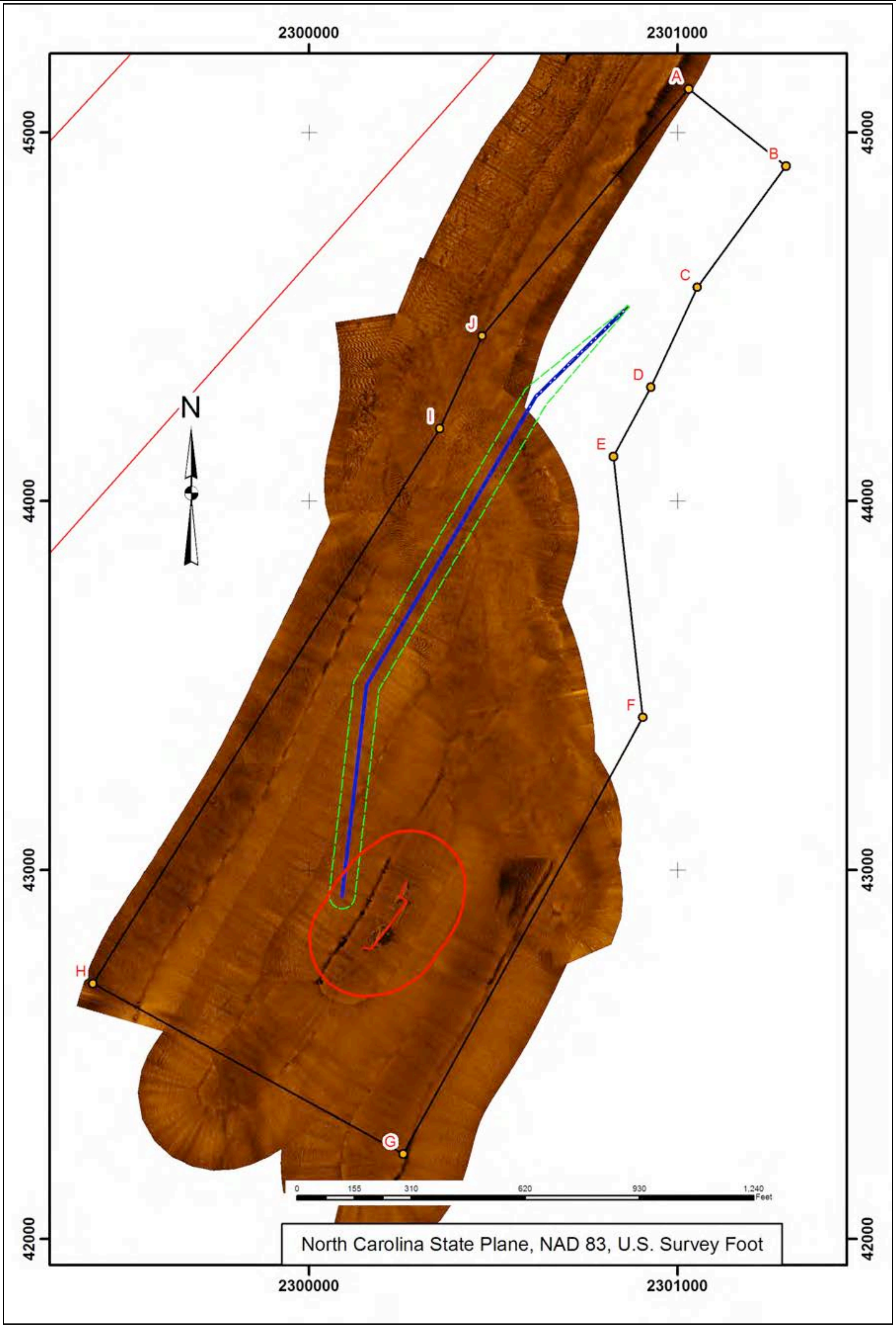

Figure 14. Wreck location with 150-foot buffer on the original groin location.

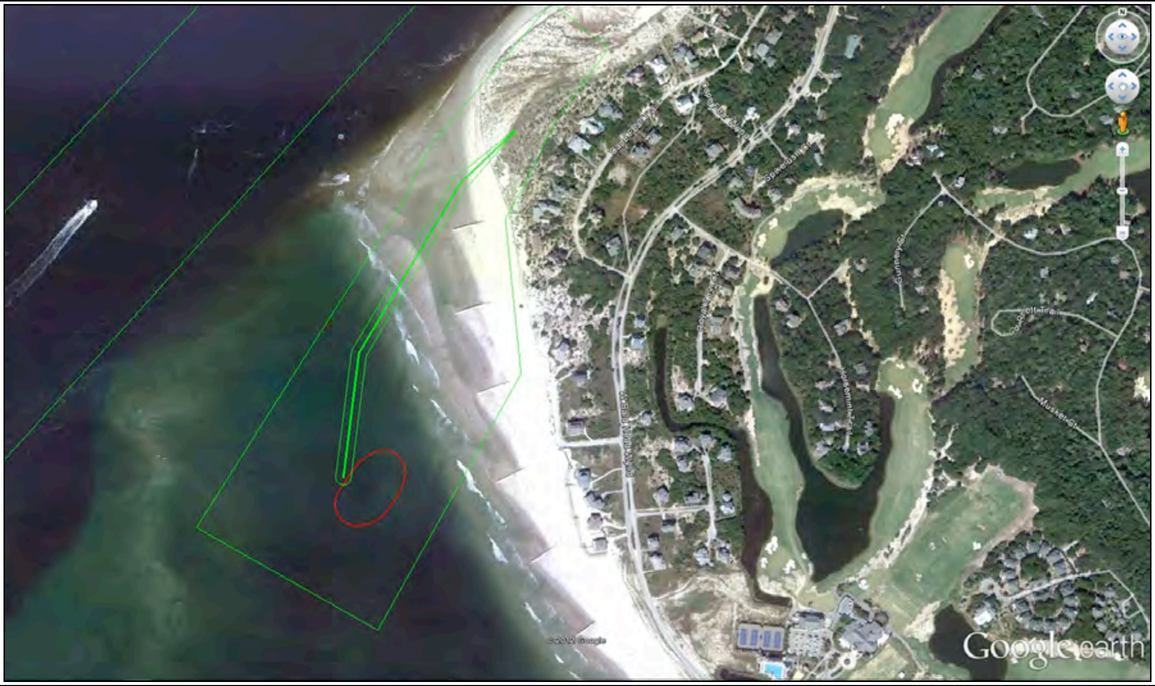

Figure 15. Location of the 150-foot wreck buffer and realigned groin.

Based on the remote sensing data only one significant anomaly was identified. That proved to be the lower hull remains of a large wooden vessel from the late 19th century or early 20th century. Documentation of the Bald Head Point shipwreck generated sufficient data to satisfy Phase II non-disturbance investigation of the vessel identified by UAB. Alteration of the alignment of the proposed groin will leave the wreck remains 150 feet southeast of the southeastern extent of construction. During construction, the contractor should be made aware of the location of the wreck and provide assurance that vessels engaged in construction of the groin will not infringe on the buffer created to preserve the surviving vessel remains. As the proposed groin is designed to foster sediment accretion along the shoreline south of Bald Head Point, the wreck remains should be recovered and thus protected. Unless changes are necessary in proposed groin construction plans, no additional investigation of the wreck is recommended.

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Appendix A

Known shipwrecks in the vicinity of the mouth of the Cape Fear River, North Carolina

Vessel	Type	Use	Date of Loss	Location	Disposition
Spanish Vessel			1526	Mouth of the Cape Fear River	
Sir John	Fly Boat		Oct. 1665	Middle Ground	
Unknown			Feb. 1767	Cape Fear River Bar	
Enterprise			15 Feb. 1768	Mouth of the Cape Fear River	
Clementine			March 1775	Middle Ground	Salvaged(?)
Unknown			Feb. 1784	Mouth of the Cape Fear River	
Neptune	Brig		26 Jan. 1789	Middle Ground	
Sabine		Privateer	11 Sept. 1814		
Florie		Blockade Runner	Oct. 1864	Inside Bar	
Georgiana McCaw		Blockade Runner	2 June 1864	SW of Baldhead Light	
Violet		U.S.S. Gunboat	7 Aug. 1864	Western Bar	Possibly cleared by USACE
Frying Pan Shoals Lightship		Light Ship	20 Dec. 1861	North of Fort Caswell	Sunk by U.S.S. *Mount Vernon*
Ellen	Schooner	Blockade Runner	26 June 1862	Burned while ashore at Bald Head Channel	Taken in tow by U.S.S. *Victoria*. Sunk in 15 minutes.
Emily	Schooner	Blockade Runner	26 June 1862	Burned under the guns of Fort Caswell	
Lizzie	Sloop	Blockade Runner	1 August 1862	Captured and burned by U.S.S. *Penobscot* off Bald Head.	
Ella	Steamer	Blockade Runner	3 Dec. 1864	Run ashore on Bald Head Beach.	Partially Salvaged
Agnes Emily Frye	Steamer	Blockade Runner	27 Dec. 1864	Lost 2 miles south of Fort Caswell off Old Inlet	
Pine	Sloop		May 1868	Cape Fear Bar	
Alex Sprunt		Lighter	Feb. 1872		
Felicitus	Bark (Ger.)		July 1874	Main Bar	Salvaged
Maria Needham	Bark (Br.)		14 Jan. 1874	Middle Ground	Salvaged
Vapor	Schooner		5 Nov. 1895	Cape Fear Bar	
San Antonio	Bark (Br.)		13 Jan. 1890		Salvaged
Ogir	Bark (Nor.)		10 Nov. 1894	Middle Ground	Salvaged
Clarence H	Schooner		9 Dec. 1902	South of Cape Fear Bar	
Col. Thos. F. Austin	Schooner		24 Feb. 1916	Middle Ground	
Unknown	Bark		13 June 1930	Middle Ground	

Appendix B

Magnetic Anomaly List
(All coordinates North Carolina State Plane, NAD 83, U.S. Survey Foot)

Map Designation	Lane	Number	Characteristics	Intensity (gammas)	Duration (feet)	X	Y	Assessment
1	2	1	Positive Monopolar	21	34	2300887.1	43583.7	Small single object
2	2	2	Dipolar	52	46	2300871.9	43457.4	Small single object
3	2	3	Negative Monopolar	23	11	2300870.3	43405.7	Associated with a temporary groin
4	1	1	Dipolar	98	34	2300762.3	43750.6	Associated with a temporary groin
5	1	2	Positive Monopolar	24	31	2300732.4	43585.7	Small single object
6	1	3	Positive Monopolar	38	24	2300758.7	43504.4	Small single object
7	1	4	Dipolar	80	43	2300785.8	43367.8	Associated with a temporary groin
8	6	1	Dipolar	8	40	2300840.3	44655.4	Small single object
9	7	1	Dipolar	61	49	2300966.7	44790.0	Small single object
10	8	1	Dipolar	44	56	2300946.8	44709.7	Small single object
11	8	2	Dipolar	17	14	2300923.8	44636.7	Small single object
12	8	3	Positive Monopolar	22	24	2300831.4	44435.8	Associated with a boardwalk
13	9	1	Positive Monopolar	65	17	2300996.6	44631.8	Associated with a boardwalk
14	9	2	Positive Monopolar	71	19	2300987.7	44614.2	Associated with a boardwalk
15	9	3	Dipolar	61	13	2300949.3	44553.8	Small single object
16	9	4	Dipolar	63	26	2300930.6	44529.4	Small single object
17	10	1	Positive Monopolar	43	27	2301178.8	44774.0	Associated with a boardwalk
18	12	1	Negative Monopolar	57	36	2301107.0	44754.5	Small single object
19	12	2	Multicomponent	192	22	2300998.5	44618.4	Associated with a boardwalk
20	12	3	Dipolar	84	25	2300918.1	44389.6	Associated with a boardwalk
21	14	1	Dipolar	84	25	2300747.5	43750.0	Associated with a temporary groin
22	15	1	Positive Monopolar	65	38	2300731.8	43756.0	Associated with a temporary groin
23	16	1	Dipolar	46	27	2300803.2	43766.3	Associated with a temporary groin
24	17	1	Positive Monopolar	11	18	2300814.2	43677.1	Small single object
25	20	1	Negative Monopolar	22	39	2300859.3	43465.1	Small single object
26	20	2	Negative Monopolar	21	19	2300824.0	43388.6	Associated with a temporary groin
27	16	2	Positive Monopolar	17	43	2300717.6	43598.9	Small single object
28	12	4	Positive Monopolar	24	11	2301218.1	44949.0	Small single object
29	14	2	Multicomponent	29	10	2300676.7	43731.7	Associated with a temporary groin
30	14	3	Dipolar	21	24	2300721.2	43746.8	Associated with a temporary groin
31	14	4	Dipolar	9	12	2300752.6	43757.3	Associated with a temporary groin
32	14	5	Positive Monopolar	127	14	2300768.2	43757.0	Associated with a temporary groin
33	14	6	Dipolar	120	27	2300737.7	43746.5	Associated with a temporary groin
34	1	7	Positive Monopolar	114	22	2300692.7	43730.2	Associated with a temporary groin

Map Designation	Lane	Number	Characteristics	Intensity (gammas)	Duration (feet)	X	Y	Assessment
35	15	2	Dipolar	90	25	2300731.8	43737.2	Associated with a temporary groin
36	15	3	Dipolar	101	20	2300758.0	43751.8	Associated with a temporary groin
37	15	4	Dipolar	10	11	2300778.7	43825.0	Small single object
38	16	3	Dipolar	25	14	2300810.0	43775.2	Associated with a temporary groin
39	1	1	Negative Monopolar	18	64	2300655.8	42998.7	Small single object
40	1	2	Positive Monopolar	2	42	2300695.7	43051.2	Small single object
41	1	3	Multicomponent	10	130	2300623.4	43357.8	Moderate single object
42	1	4	Multicomponent	10	95	2300565.7	43694.5	Associated with a temporary groin
43	1	5	Positive Monopolar	6	37	2300551.6	43911.5	Small single object
44	1	6	Negative Monopolar	6	43	2300547.5	44120.6	Small single object
45	1	7	Multicomponent	6	58	2300557.6	44226.1	Small single object
46	1	8	Dipolar	3	33	2300562.0	44297.1	Small single object
47	1	9	Dipolar	6	64	2300555.3	44383.3	Small single object
48	19	1	Positive Monopolar	6	75	2300410.6	44565.9	Small single object
49	19	2	Dipolar	10	68	2300415.9	44462.7	Small single object
50	19	3	Multicomponent	14	84	2300397.0	44327.5	Small single object
51	19	4	Multicomponent	28	122	2300466.9	43677.4	Moderate single object
52	19	5	Multicomponent	43	155	2300515.0	43525.2	Moderate single object
53	19	6	Positive Monopolar	4	29	2300547.3	43366.7	Small single object
54	19	7	Negative Monopolar	7	58	2300559.1	43295.5	Small single object
55	19	8	Positive Monopolar	3	30	2300575.2	43187.2	Small single object
56	19	9	Multicomponent	8	116	2300645.2	43027.7	Small single object
57	20	1	Dipolar	22	133	2300512.4	43105.8	Moderate single object
58	20	2	Negative Monopolar	4	42	2300479.9	43352.6	Small single object
59	20	3	Negative Monopolar	9	66	2300327.1	43911.9	Possible Cable
60	20	4	Dipolar	3	37	2300352.8	44037.7	Small single object
61	20	5	Positive Monopolar	8	49	2300399.9	44281.5	Small single object
62	20	6	Dipolar	11	93	2300398.7	44369.1	Small single object
63	20	7	Positive Monopolar	6	65	2300407.2	44562.9	Small single object
64	20	1	Dipolar	6	56	2300419.5	44464.8	Small single object
65	20	2	Dipolar	21	90	2300391.8	44372.8	Moderate single object
66	20	3	Positive Monopolar	4	49	2300296.6	44071.1	Small single object
67	20	4	Dipolar	4	53	2300222.2	43960.2	Small single object
68	18	1	Positive Monopolar	3	36	2300304.7	44052.3	Small single object

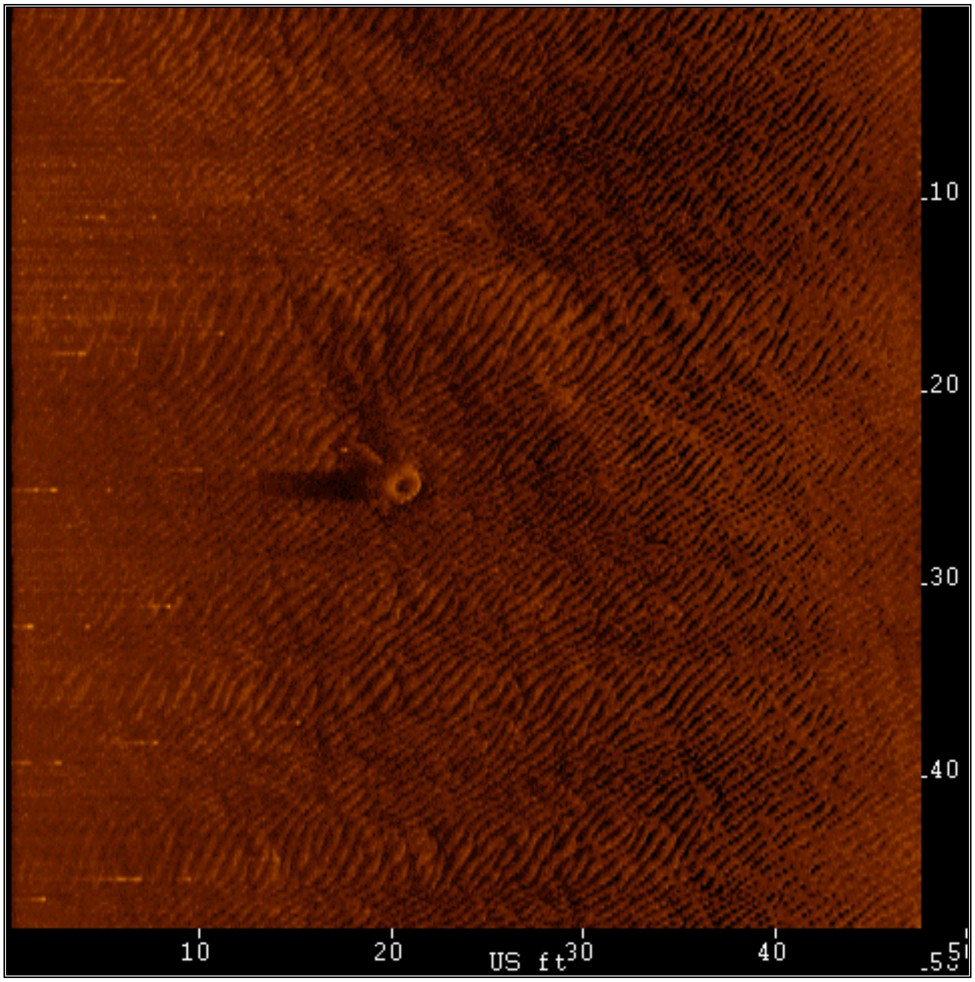
Map Designation	Lane	Number	Characteristics	Intensity (gammas)	Duration (feet)	X	Y	Assessment
69	18	2	Dipolar	3	39	2300336.6	44101.2	Small single object
70	17	1	Dipolar	19	49	2300443.4	44221.4	Moderate single object
71	17	2	Multicomponent	6	44	2300391.0	44147.4	Small single object
72	17	3	Dipolar	4	58	2300388.7	44084.7	Small single object
73	17	4	Negative Monopolar	2	59	2300318.8	43919.9	Possible Cable
74	16	1	Dipolar	27	104	2299656.6	42625.7	Moderate single object
75	16	2	Negative Monopolar	8	48	2300099.2	43438.2	Small single object
76	15	1	Dipolar	54	87	2300357.5	43898.4	Possible Cable
77	15	2	Positive Monopolar	5	42	2300367.9	43966.7	Small single object
78	15	3	Multicomponent	6	101	2300384.9	43864.7	Possible Cable
79	15	4	Positive Monopolar	4	62	2300308.9	43671.7	Small single object
80	3	1	Multicomponent	18	96	2300539.1	43180.4	Moderate single object
81	3	2	Dipolar	4	55	2300588.0	43057.4	Small single object
82	5	1	Positive Monopolar	4	68	2300621.2	43188.8	Small single object
83	5	2	Positive Monopolar	3	57	2300584.5	43255.2	Small single object
84	5	3	Negative Monopolar	3	40	2300538.2	43206.7	Small single object
85	5	4	Dipolar	58	85	2300504.5	43112.6	Moderate single object
86	**6**	**1**	**Multicomponent**	**24**	**286**	**2300238.4**	**42784.8**	**Associated with a shipwreck**
87	7	1	Negative Monopolar	3	56	2300569.9	43286.3	Small single object
88	7	2	Dipolar	13	92	2300578.9	43395.1	Small single object
89	**7**	**3**	**Multicomponent**	**68**	**275**	**2300246.0**	**42815.8**	**Associated with a shipwreck**
90	**8**	**1**	**Multicomponent**	**362**	**320**	**2300163.2**	**42806.9**	**Associated with a shipwreck**
91	10	1	Multicomponent	86	77	2300518.1	43584.4	Moderate single object
92	10	2	Dipolar	23	78	2300361.1	43227.7	Moderate single object
93	**10**	**3**	**Multicomponent**	**22**	**263**	**2300158.5**	**42883.8**	**Associated with a shipwreck**
94	11	1	Negative Monopolar	4	87	2300127.5	42956.7	Small single object
95	11	2	Dipolar	4	44	2300333.3	43329.4	Small single object
96	11	3	Dipolar	9	52	2300414.1	43466.9	Small single object
97	12	1	Multicomponent	53	104	2300494.1	43692.5	Moderate single object
98	12	2	Dipolar	3	41	2300175.5	43132.7	Small single object
99	13	1	Dipolar	6	103	2299976.6	42909.3	Small single object
100	13	2	Positive Monopolar	5	90	2300204.9	43303.2	Small single object
101	14	1	Multicomponent	19	58	2300426.0	43838.4	Possible Cable
102	21	1	Positive Monopolar	26	139	2299542.3	42844.4	Moderate single object

Map Designation	Lane	Number	Characteristics	Intensity (gammas)	Duration (feet)	X	Y	Assessment
103	21	2	Multicomponent	30	173	2299741.5	43192.3	Tire
104	22	1	Positive Monopolar	6	78	2299523.5	42859.3	Small single object

Appendix C

Sonar Targets

SS-1



Contact Info: SS-1

- Sonar Time at Target: 08/03/2012 12:37:14
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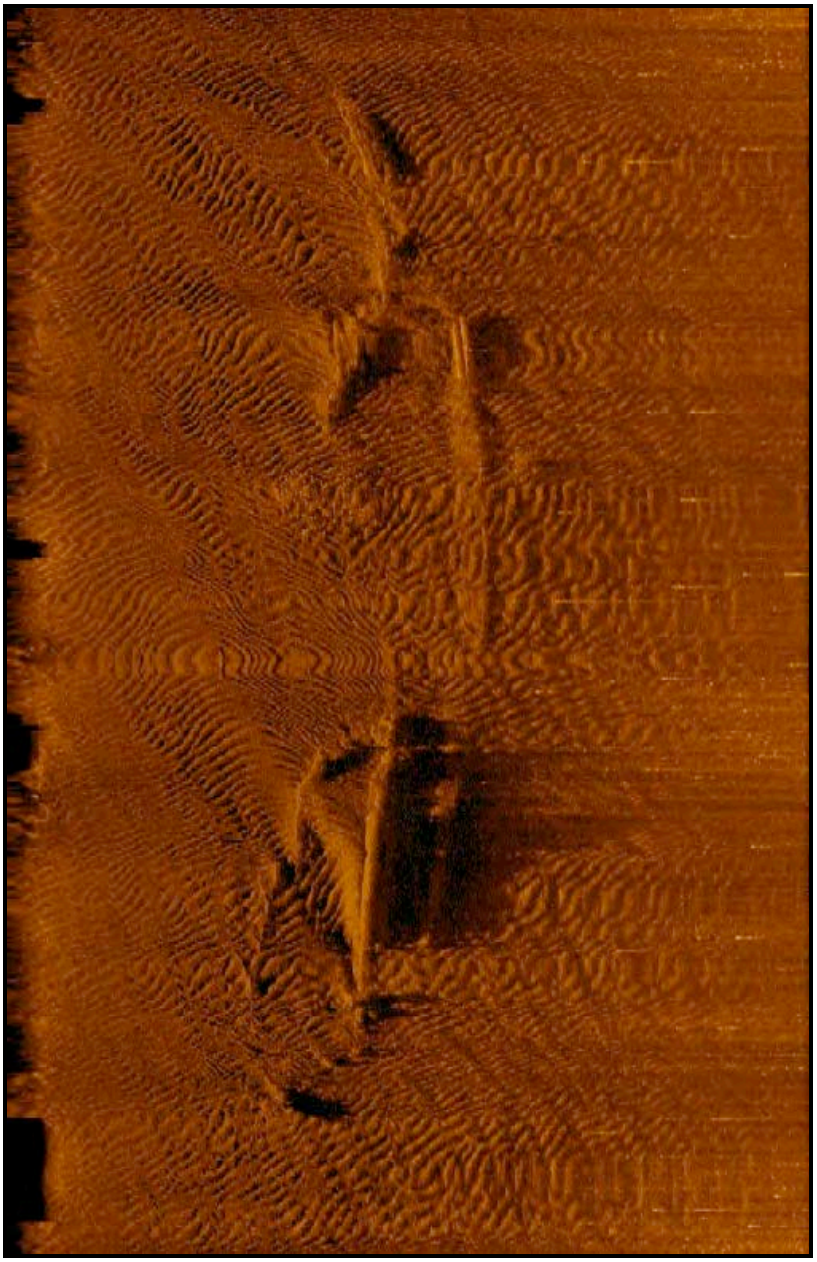
- Click Position (Projected Coordinates)
  (X) 2299745.37 (Y) 43175.20
- Map Proj: NC83F
- Acoustic Source File: BHI12_L_15_120803085400.xtf
- Ping Number: 5268
- Range to Target: 29.63 US Feet
- Fish Height: 3.86 US Feet
- Heading: 55.500 degrees
- Event Number: 0
- Water Depth: 0.00
- Line Name: 15

User Entered Info

Target Height: 2.2 US Feet
Target Length: 6.9 US Feet
Target Shadow: 20.6 US Feet
Target Width: 6.9 US Feet
Mag Anomaly: 103
Avoidance Area: No
Classification 1: Tire
Area: Bald Head Island
Description: A single tire.

SS-2



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- Map Proj: NC83F
- Acoustic Source File: BHI12_L_15_120803092000.xtf
- Ping Number: 31243
- Range to Target: 23.73 US Feet
- Fish Height: 3.42 US Feet
- Heading: 206.600 degrees
- Event Number: 0
- Water Depth: 0.00
- Line Name: 15

User Entered Info

Target Height: 4.6 US Feet
Target Length: 194.3 US Feet
Target Shadow: 54.1 US Feet
Target Width: 31.7 US Feet
Mag Anomaly: 86, 89, 90, 93
Avoidance Area: Yes
Classification 1: Wreck
Area: Bald Head Island
Description: Shipwreck

North Carolina Department of Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Pat McCrory, Governor
Susan W. Kluttz, Secretary
Kevin Cherry, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

January 17, 2013

Dave Timpy
US Army Corps of Engineers
Wilmington Regulatory Field Office
69 Darlington Avenue,
Wilmington, NC 28403

Re: Construction of a Terminal Groin at the Juncture of Bald Head Island and the Entrance to the Cape Fear River, SAW 2012-00040, Brunswick County, ER 12-0437

Dear Mr. Timpy,

We have received the archaeological survey report "A Phase I Remote-Sensing Archaeological Survey & Phase II Shipwreck Assessment at the Location of a Proposed Terminal Groin at the Mouth of the Cape Fear River, Bald Head Island, Brunswick County, North Carolina" from Tidewater Atlantic Research, Inc. (TAR) for the above project. The report meets our office's guidelines and those of the Secretary of the Interior and we would like to take this opportunity to comment.

The terrestrial and underwater survey conducted by TAR identified 104 magnetic anomalies and two acoustic targets. A cluster of four magnetic anomalies (86, 89, 90, and 93) associated with one acoustic signature were generated by the remains of a vessel requiring additional archaeological investigation. The remaining targets were determined to not warrant further investigation.

A Phase II non-disturbance investigation of the shipwreck remains, determined it to be a large wood hull sailing vessel dating to the late 19th or early 20th century. This shipwreck is deemed potentially eligible and requires avoidance. Because the wreck is located within 70 feet of the proposed groin location, TAR proposed a shift in the construction alignment to provide a minimum 150 foot buffer. We concur with this recommendation that a 150 foot buffer is required around the wreck location. Additionally, during construction all contractors should be made aware of the location of the wreck and provide assurance that vessels and equipment engaged in construction of the groin will not infringe on the buffer created, to preserve the surviving vessel remains.

These comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, North Carolina legislation (G.S. 121-22 to 28, Article 3), and the Abandoned Shipwreck Act of 1987 (P.L. 100-298).

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above referenced ER tracking number.

Sincerely,

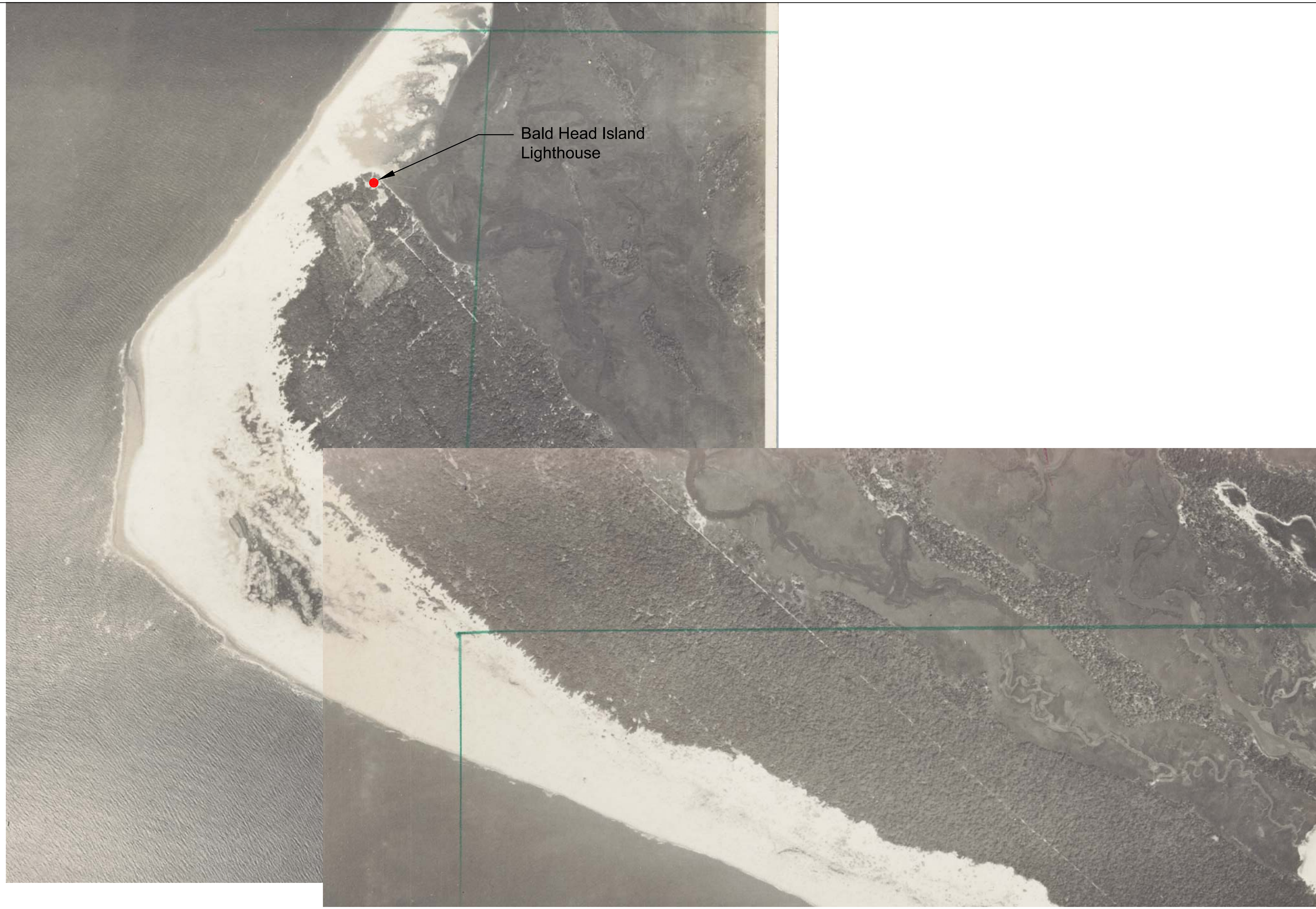
Renee Gledhill-Earley

for Ramona M. Bartos

cc: Chris McCall, Village of Bald Head Island
Eric Olsen, Olsen Associates, Inc.

APPENDIX I

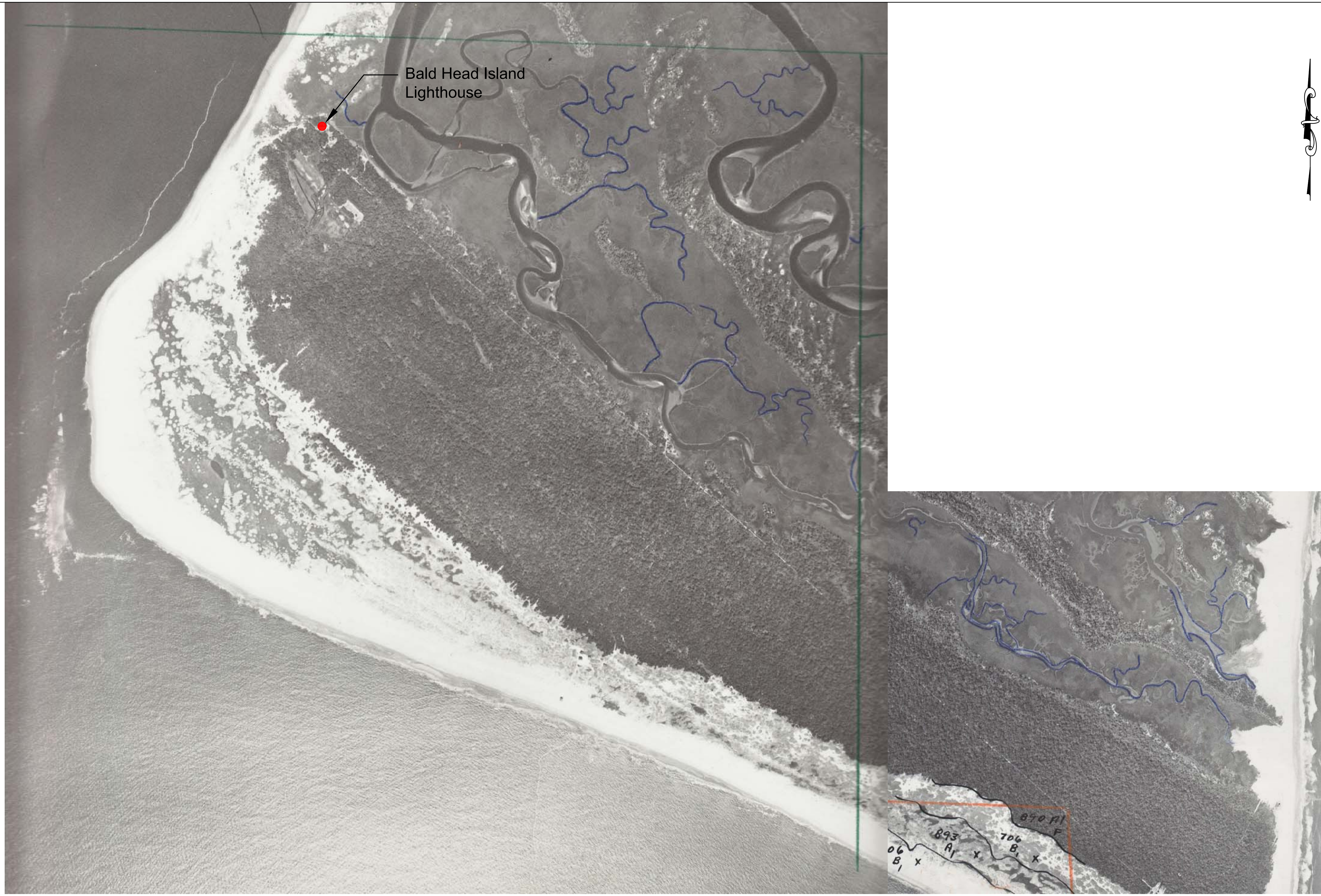
BALD HEAD ISLAND HISTORIC AERIAL IMAGERY



Aerial photography from NRCS.

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**		Date: 4/2013	Revision Date: NA
		Scale: **1"=1200'**	Job Number: 40-11-238
Title: ***1938 NRCS Aerial***		Drawn By:	Figure:



Aerial photography from NRCS.

0 600 1200 2400

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 4/2013	Revision Date: NA
	Scale: **1"=1200'**	Job Number: 40-11-238
Title: ***1956 NRCS Aerial***	Drawn By:	Figure:

Aerial photography from NRCS.

0 600 1200 2400

LMG LAND MANAGEMENT GROUP INC. Environmental Consultants Post Office Box 2522 Wilmington, North Carolina 28402 Telephone: 910-452-0001	Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 4/2013	Revision Date: NA
	Title: ***1972 NRCS Aerial***	Scale: **1"=1200'**	Job Number: 40-11-238
		Drawn By:	Figure:

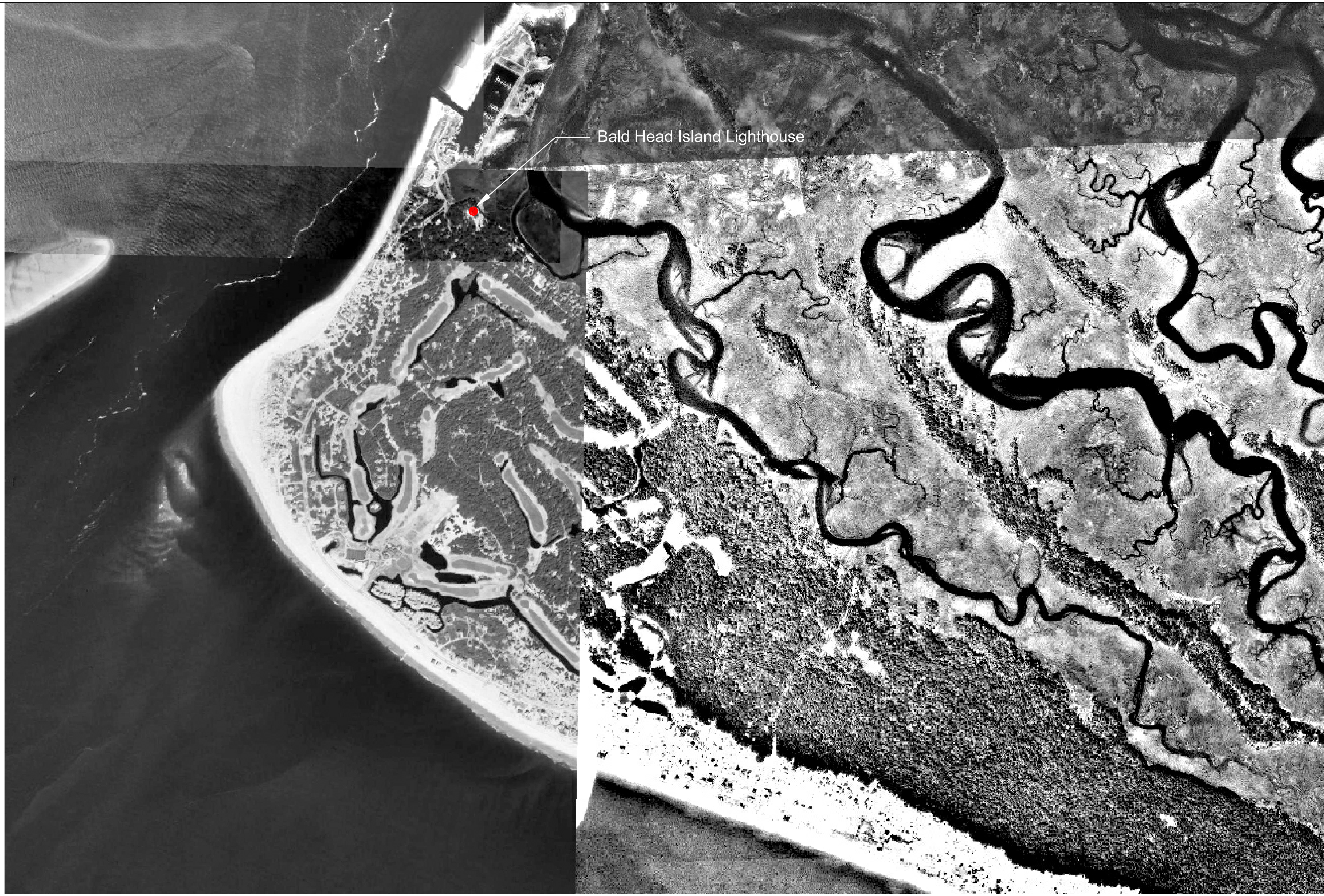
Aerial photography from NRCS.

0 600 1200 2400

LMG LAND MANAGEMENT GROUP INC. Environmental Consultants

Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 4/2013	Revision Date: NA
Title: ***1981 NRCS Aerial***	Scale: **1"=1200'**	Job Number: 40-11-238
	Drawn By:	Figure:



Aerial photography from USDA-NRCS.

0 600 1200 2400

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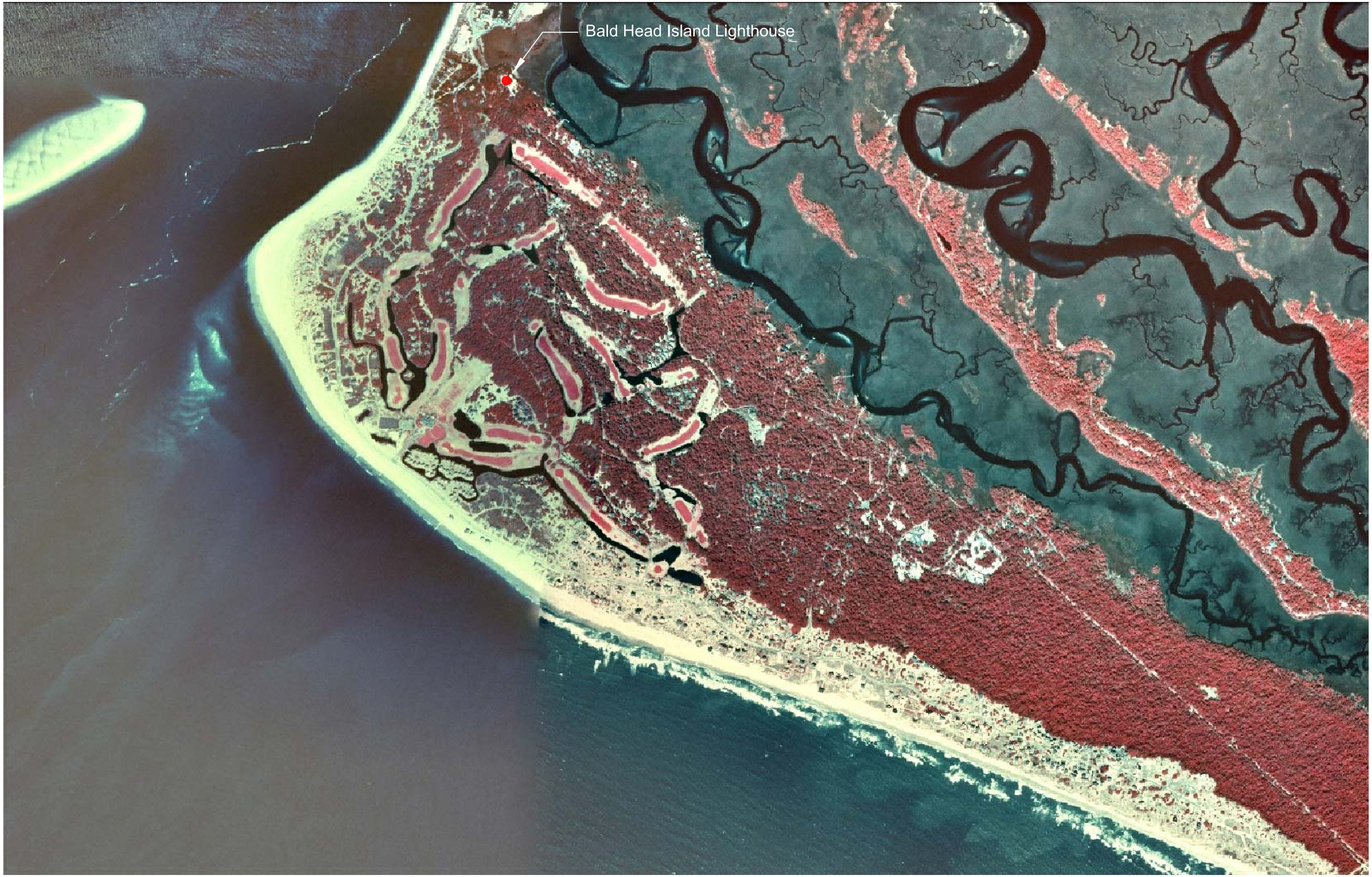
Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 4/2013	Revision Date: NA
	Scale: **1"=1200'**	Job Number: 40-11-238
Title: ***1993 NAPP Aerial***	Drawn By:	Figure:



Aerial photography from USDA-NRCS.

0 600 1200 2400

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	Scale: **1"=1200'**	Job Number: 40-11-238	
Title: ***1998 NAPP Aerial***	Drawn By:	Figure:	

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Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 4/2013	Revision Date: NA
	Scale: **1"=1200'**	Job Number: 40-11-238
Title: ***2004 Aerial Photograph***	Drawn By:	Figure:

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Title: ***2008 Aerial Photograph***	Scale: **1"=1200'**	Job Number: 40-11-238
	Drawn By:	Figure:

Aerial photography from USDA-NRCS.

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Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 4/2013	Revision Date: NA
	Scale: **1"=1200'**	Job Number: 40-11-238
Title: ***2010 Aerial Photograph***	Drawn By:	Figure:

APPENDIX J

BIRD NESTING DATA (1984-2011)

Appendix J. Bald Head Island shorebird monitoring data between 1984 and 2011 provided by NC Wildlife Resources Commission.

Date	Species	Number of Birds	Number of Breeding Pairs	Habitat	Landside	Comments	Latdeg	Latmin	Longdeg	Longmin	Lat-Long Accuracy
1984	Piping Plover	10		sand spit-inlet beach	inlet	New Inlet --from old data compiled by John Fussell -- American Birds and Bill Brokaw	33	54	77	52.20000076	estimate from map
1985	Piping Plover	2			inlet	New Inlet -data from American Birds, Bill Brokaw, John Fussell	33	54	77	52.20000076	estimate from map
1986	Piping Plover	1			inlet	New Inlet -data from American Birds, Bill Brokaw, John Fussell	33	54	77	52.20000076	estimate from map
1987	Piping Plover	1			inlet	New Inlet- data from American Birds, Bill Brokaw, John Fussell	33	54	77	52.20000076	estimate from map
1988	Piping Plover	0			inlet	New Inlet- data from American Birds, Bill Brokaw, John Fussell	33	54	77	52.20000076	estimate from map
1989	Piping Plover	0			inlet	New Inlet- data from American Birds, Bill Brokaw, John Fussell	33	54	77	52.20000076	estimate from map
1987	Piping Plover	1				from data compiled by David Allen	33	54	77	52.20000076	estimate from map
1989	Piping Plover	4				from data compiled by David Allen	33	54	77	52.20000076	estimate from map
5/26/1989	Wilson's Plover	17	8	sand beach/dunes/sand spit-inlet beach	ocean, inlet	8 pairs and 1 territorial female, 1 nest found with 3 eggs, 3 young chicks seen also.	33	54	77	52.20000076	estimate from map
5/26/1989	Piping Plover	0				Areas surveyed: From Mouth of Bald Head Creek to beyond the river point, from site of old coast guard station (Capt. Charlie's) to the cape point and N to New Inlet	33	54	77	52.20000076	estimate from map
12/31/1990	Piping Plover	0			ocean, inlet	South side of New inlet (shoaled in since then)	33	54.7999992	77	57	estimate from map
1/19/1991	Piping Plover	0					33	51	77	58	estimate from map:center of larger area covered
6/8/1991	Piping Plover	0					33	51	77	58	estimate from map
7/1/1994	Piping Plover	0					33	51	77	58	estimate from map:center of larger area covered
1/18/1996	Piping Plover	0					33	54	77	52.20000076	estimate from map

Appendix J. Bald Head Island shorebird monitoring data between 1984 and 2011 provided by NC Wildlife Resources Commission.

6/1/1996	Piping Plover	0					33	54	77	52.20000076	estimate from map
7/1/1997	Piping Plover	0					33	51.4000015	78	0	estimate from map
7/1/1998	Piping Plover	0					33	54	77	52.20000076	estimate from map
6/1/1999	Piping Plover	0					33	54	77	52.20000076	estimate from map
7/1/1999	Piping Plover	0					33	54	77	52.20000076	estimate from map
6/1/2000	Piping Plover	0					33	54	77	52.20000076	estimate from map
7/1/2000	Piping Plover	1				north end	33	54	77	52.20000076	estimate from map
9/28/2000	Piping Plover	1					33	54.9000015	77	55.79999924	estimate from map
11/17/2000	Piping Plover	1			ocean		33	51.5	78	0.5	estimate from map
2/1/2001	Piping Plover	0					33	50.7799988	77	57.93999863	hand held GPS
3/3/2001	Piping Plover	1		sand beach/intertidal surf	ocean	50 yards west of Captain Charlie's crossover (.75 mi west of Cape Fear)	33	51.3300018	78	0	estimate from map
3/22/2001	Piping Plover	2		dunes	ocean	chasing Wilson's, these 2 pipers were in the are of beach disposal	33	52	78	0.600000024	estimate from map
3/22/2001	Piping Plover	1		sand beach/intertidal surf	ocean	100 yards east if Captain Charlie's crossover (.25 mi west of Cape Fear)	33	51.5	78	0.330000013	estimate from map
3/27/2001	Piping Plover	0					33	52	78	0.600000024	estimate from map
3/27/2001	Piping Plover	1		sand beach	ocean	east of Cpt. Charlie's crossover (.25 mi west of Cape Fear)	33	51.5	78	0.330000013	estimate from map
3/27/2001	Piping Plover	3		sand beach/intertidal surf	ocean	east of Cpt. Charlie's crossover (.5 mi west of Cape Fear)	33	51.4000015	78	0.25	estimate from map
5/26/2001	Piping Plover	0		sand beach/dunes/mudf lat-sandflat	ocean	west beach	33	52.1100006	78	0.629999995	hand held GPS
5/26/2001	Piping Plover	0		sand beach/dunes/mudf lat-sandflat	ocean	Cape Fear	33	50.5600014	77	57.68000031	hand held GPS
5/26/2001	Piping Plover	0		sand beach/dunes/mudf lat-sandflat	ocean	south beach	33	51.1100006	77	59.20000076	hand held GPS

Appendix J. Bald Head Island shorebird monitoring data between 1984 and 2011 provided by NC Wildlife Resources Commission.

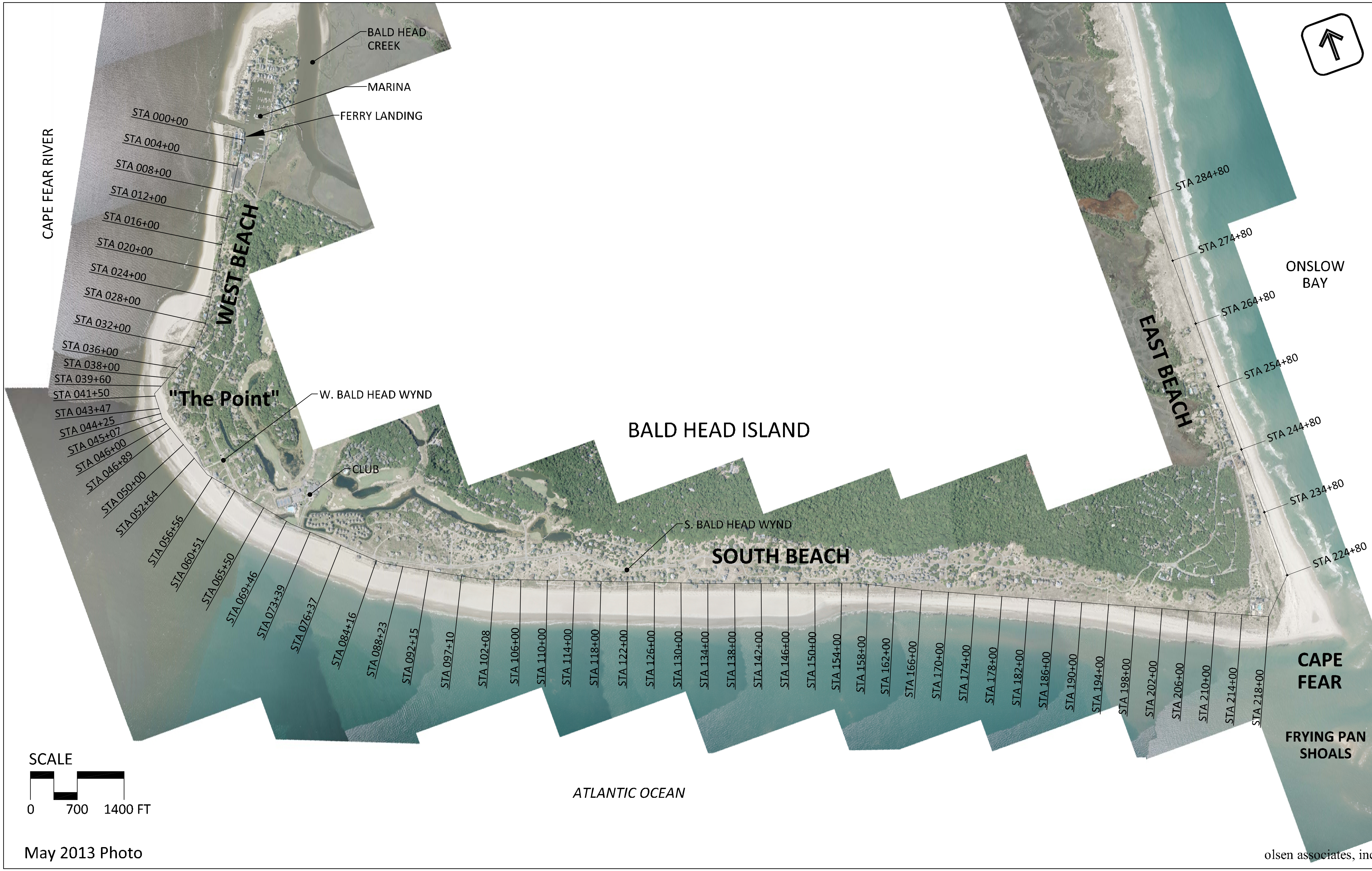
5/30/2001	Piping Plover	0				sand disposal on beach front in center part of survey area- this area not surveyed	33	51.5499992	78	0.600000024	estimate from map
5/30/2001	Wilson's Plover	18	9	overwash/dunes	ocean	9 breeding pairs	33	54	77	52.20000076	estimate from map
5/30/2001	American Oystercatcher	2	1	overwash/dunes	ocean	1 breeding pair	33	54	77	52.20000076	estimate from map
5/30/2001	Willet	22	11	overwash/dunes	ocean	11 breeding pairs	33	54	77	52.20000076	estimate from map
6/2/2001	Piping Plover	0		sand beach/dunes/mudflat-sandflat	ocean	Cape Fear	33	50.5600014	77	57.68000031	hand held GPS
6/2/2001	Piping Plover	0		sand beach/dunes/mudflat-sandflat	ocean	west beach	33	52.1100006	78	0.629999995	hand held GPS
6/2/2001	Piping Plover	0		sand beach/dunes/mudflat-sandflat	ocean	south beach	33	51.1100006	77	59.20000076	hand held GPS
7/1/2001	Piping Plover	0					33	51.5	78	0	estimate from map
7/8/2001	Piping Plover	5		intertidal surf	ocean	.25 mi. west of Cape Fear	33	50.5	77	58.15000153	estimate from map
8/16/2001	Piping Plover	1		intertidal surf	ocean	near mouth of Cape Fear river	33	51.5999985	78	0.600000024	estimate from map
7/1/2002	Piping Plover	0		sand beach/sand spit-inlet beach	inlet, sound, ocean		33	51	77	58	survey not site specific
8/23/2002	Piping Plover	1		sand beach/intertidal surf	ocean	midway btwn Cape Fear and the mouth of the Cape Fear River, no bands	33	50.5600014	77	57.68000031	estimate from map
9/13/2002	Piping Plover	1		intertidal surf	ocean	.5 miles W of Cape Fear, no bands	33	51.4000015	78	0.25	estimate from map
11/25/2002	American Oystercatcher	30				aerial survey	33	51	77	58	survey not site specific
6/23/2003	Piping Plover	0					33	51	77	58	survey not site specific
6/4/2004	American Oystercatcher	2	1		ocean	~2 miles past sign; 1 breeding pair	33	52.9000015	77	57.5	survey not site specific
6/4/2004	Wilson's Plover	2	1		ocean	1 breeding pair; nest with 3 eggs observed at th The Point	33	50.5	77	57.79999924	estimate from map

Appendix J. Bald Head Island shorebird monitoring data between 1984 and 2011 provided by NC Wildlife Resources Commission.

6/4/2004	Wilson's Plover	2	1		ocean	1 breeding pair; 1 chick observed in a washover behind the first row of dunes. Another male flew into pairs territory causing pair to defend chick and territory; ~2 miles past sign	33	52.9000015	77	57.5	estimate from map
7/1/2005	Piping Plover	0					33	51	77	58	survey not site specific
2/1/2006	Piping Plover	0					33	51	77	58	survey not site specific
5/2/2006	Piping Plover	4			ocean	South Point	33	51	77	58	survey not site specific
6/7/2006	Red Knot	30				east beach	33	51	77	58	survey not site specific
6/7/2006	Piping Plover	0				mid and rising tide	33	51	77	58	estimate from map:center of larger area covered
7/1/2006	Piping Plover	0	0				33	51	77	58	survey not site specific
6/6/2007	Wilson's Plover	1				North End of Island; non committal - possibly just a single male	33	54.428299	77	56.90650177	estimate from map:center of larger area covered
6/6/2007	American Oystercatcher	4	2			N end of Bald Head Island - 2 pair on beach - appear to be finished nesting	33	54.428299	77	56.90650177	estimate from map:center of larger area covered
6/6/2007	Wilson's Plover	4	2			South Point; one territory had nest with 3 eggs; other had agitated adults	33	50.5974998	77	57.74449921	estimate from map
6/6/2007	Wilson's Plover	16	8			North End of Bald Head Island - defensive behavior	33	54.428299	77	56.90650177	estimate from map:center of larger area covered
2010	American Oystercatcher	2	1			Observed by Emily Rice (waterbird biotech)					
2011	Wilson's Plover	6	3			Observed by BHIC.					

APPENDIX K

STATION LOCATION MAP



Island-wide beach monitoring baseline.

APPENDIX L

ENVIRONMENTAL CONSEQUENCES SUMMARY TABLE
(BY ALTERNATIVE)

Appendix L. Summary of Direct, Indirect, and Cumulative Environmental Consequences by Alternative

Resource	Description of Stressor	Direct (D, Indirect (I)	Alt 1		Alt 2		Alt 3		Alt 4		Alt 5		Alt 6	
Threatened and Endangered Species			Level of Effect	Potential for Cumulative Effect (Y or N)	Level of Effect	Potential for Cumulative Effect (Y or N)	Level of Effect	Potential for Cumulative Effect (Y or N)	Level of Effect	Potential for Cumulative Effect (Y or N)	Level of Effect	Potential for Cumulative Effect (Y or N)	Level of Effect	Potential for Cumulative Effect (Y or N)
Marine Mammals	Collision Threat	D	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N
	Effects to Foraging Habitat	I	Absent to Low	N	Absent	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N
Sea Turtles	Collision Threat	D	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N
	Physical Loss of Nesting Habitat	I	Moderate to High	N	High	N	Low	N	High	N	Low	N	Low to Moderate	N
	Beach Compaction/Compatability	I	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N
	Beach Impediments (e.g. Escarpments) to Adult Females	I	Low to Moderate	N	Moderate	N	Low to Moderate	N	Moderate	N	Low to Moderate	N	Low to Moderate	N
	Structural Impediments/Interference with Adult Females or Hatchlings	I	Low to Moderate (Groinfield)	N	Absent	N	Low to Moderate (Groinfield)	N	Absent	N	Moderate to High	N	Low to Moderate	N
	Predator Concentration	I	Low to Moderate (Groinfield)	N	Absent	N	Low to Moderate (Groinfield)	N	Absent	N	Moderate to High	N	Low to Moderate	N
Birds	Physical Loss of Nesting Habitat	I	Absent to Low	N	Moderate to High	N	Low to Moderate	N	Moderate to High	N	Low	N	Low	N
	Degradation of Nesting Habitat	I	Absent to Low	N	Moderate to High	N	Low to Moderate	N	Moderate to High	N	Low	N	Low	N
	Physical Loss of Foraging Habitat	I	Moderate to High	N	Moderate to High	N	Low to Moderate	N	Moderate to High	N	Low	N	Low	N
	Degradation of Foraging Habitat (e.g. reduced prey abundance)	I	Moderate	N	Low	N	Moderate	N	Moderate	N	Low to Moderate	N	Moderate	N
	Nest Interference	I	Low to Moderate	N	Absent to Low	N	Low to Moderate	N	Low to Moderate	N	Low	N	Low to Moderate	N
Fish	Entrainment	D	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N	Absent to Low	N
	Effects to Water Column	I	Low	N	Low	N	Low	N	Low	N	Low	N	Low	N
	Effects to Larval Transport	I	Absent	N	Absent	N	Absent	N	Absent	N	Absent to Low	N	Absent to Low	N
	Effects to Foraging Habitat	I	Low	N	Low	N	Low	N	Low to Moderate	N	Low	N	Low	N
	Effects to Ingress/Egress to Estuary	I	Absent	N	Absent	N	Absent	N	Absent	N	Absent to Low	N	Absent to Low	N
Plants	Physical Loss of Habitat	D, I	Moderate to High	N	High	N	Moderate	N	High	N	Low	N	Low	N
	Degradation of Habitat/Effects to Germination and Growth	D, I	Moderate	N	Moderate	N	Moderate to High	N	Moderate to High	N	Moderate	N	Moderate	N
Habitat Type														
Subtidal Bottom	Physical Loss	D, I	Absent	N	Absent	N	Absent	N	Absent	N	Low	N	Low	N
	Habitat Degradation	I	Low	N	Absent	N	Moderate	N	Moderate	N	Low to Moderate	N	Low to Moderate	N
Wet Beach	Physical Loss	D, I	Low	N	Low	N	Low	N	Low	N	Low	N	Low	N
	Habitat Degradation	I	Moderate	N	Low to Moderate	N	Moderate	N	Moderate to High	N	Low	N	Low	N
Dry Beach	Physical Loss	D, I	High	N	High	Y	Moderate	N	Moderate to High	Y	Low	N	Low	N
	Habitat Degradation	I	Moderate	N	Moderate to High	N	Moderate	N	Moderate to High	N	Low to Moderate	N	Moderate	N
Dunes	Physical Loss	D, I	Moderate to High	N	High	Y	Low to Moderate	N	High	Y	Low	N	Low	N
	Habitat Degradation	I	Low to Moderate	N	Moderate to High	N	Low to Moderate	N	Moderate	N	Low to Moderate	N	Moderate	N
Interdunal Wetlands	Physical Loss	D, I	Absent to Low	N	High	N	Absent to Low	N	High	N	Absent	N	Absent	N
	Habitat Degradation	I	Absent to Low	N	Low to Moderate	N	Absent to Low	N	Low to Moderate	N	Absent	N	Absent	N
Maritime Thicket/Forest	Physical Loss	D, I	Absent	N	High	N	Absent	N	High	N	Absent	N	Absent	N
	Habitat Degradation	I	Absent	N	Moderate to High	N	Absent	N	Moderate to High	N	Absent	N	Absent	N
Estuarine Salt Marsh	Physical Loss	D, I	Absent	N	Absent	N	Absent	N	Absent	N	Absent	N	Absent	N
	Habitat Degradation	I	Absent	N	Absent	N	Absent	N	Absent	N	Absent	N	Absent	N

APPENDIX M

FISH LARVAE RESPONSE MODEL

Project-related impacts to Tidal Hydraulics and Potential Transport of Fish Larvae Following Terminal Groin Construction Bald Head, North Carolina

June 14, 2012
Revised September 26, 2012

Abstract. The Delft3D numerical model was employed to compute potential differences in hydraulics following construction of a semi-permeable terminal groin at the western terminus of Bald Head Island, North Carolina. The previously calibrated depth-averaged, tide-only model was reconfigured and run to describe tides during a 30-day spring-neap lunar cycle under both beach fill only and terminal groin with beach fill conditions. Several drogues were placed in the nearshore waters off Bald Head in order to track the potential hydraulic pathways of nondescript particles (hypothetical fish larvae) from the nearshore into the inlet on route to the interior estuary system. Tidal currents, drogue routes, and travel duration were directly compared under with and without project conditions. Additionally, the Delft3D particle tracking model was applied to the hydrodynamic model result in order to simulate instantaneous, localized deployment of multiple particles in the nearshore of Bald Head Island and map said particle movements and concentrations throughout the domain under with- and without- terminal groin conditions. The results of these analyses suggest that a terminal groin at Bald Head will have no far-reaching effects on the tidal hydraulics of the inlet. Differences in tidal flows are minor and localized about the general vicinity of the structure. These predicted alterations to tidal flows are not expected to meaningfully hamper the ability of suspended biota or fish larvae to reach the inlet from the nearshore waters proximate to Bald Head.

The Delft3D model was utilized to simulate the effects of the proposed terminal groin on tidal flows. Calibration of the depth-averaged model is discussed in detail under separate cover[1]. Two model domains were developed for this investigation, the first includes a 1.2 Mcy beach fill which extends along the south-facing shoreline of Bald Head between Station 166+00 and the Point. This simulation reflects erosion control measures which have been historically employed along Bald Head Island. The second model scenario includes the proposed, semi-permeable terminal groin with placement of 1.2 Mcy of beach nourishment, the distribution of which differs from the beach fill only condition in order to pre-fill the fillet east of the terminal groin requiring a beach fill which effectively terminates at about Station 130+00.

[1] Olsen, 2012. "Calibration of a Delft3D model for Bald Head Island and the Cape Fear River Entrance. Phase I." Prepared for the Village of Bald Head Island. Prepared by Olsen Associates, Inc. 2618 Herschel Street Jacksonville, FL 32204. April 2012.

The sixteen existing tube groins were conservatively represented in both models as thin dams, an impermeable and infinitely tall impediment to flow in the model. The proposed permeable terminal groin was modeled as a porous plate, the permeability of which is controlled by a friction term which was set to 4.5 for these simulations, roughly representing a level of permeability between about 10 and 30 percent by best estimation.

The tide-only model was driven by water level fluctuations derived via astronomical constituents developed by the Topex/Posiden constituent model database. Tidal phase and amplitude for the following twelve constituents were specified for 49 contiguous boundary segments along the flow domain: M2, S2, N2, K2, K1, O1, P1, Q1, MF, and MM. The model was run for a period of 30 days in order to simulate a complete spring-neap lunar cycle. Water elevation computed by the model at Southport is shown in **Figure 1**. The annual tide range shown in **Figure 2** illustrates an overall lack of significant seasonal variability in the tides near the study area, which suggests the period selected for analysis herein is a reasonable proxy for typical conditions.

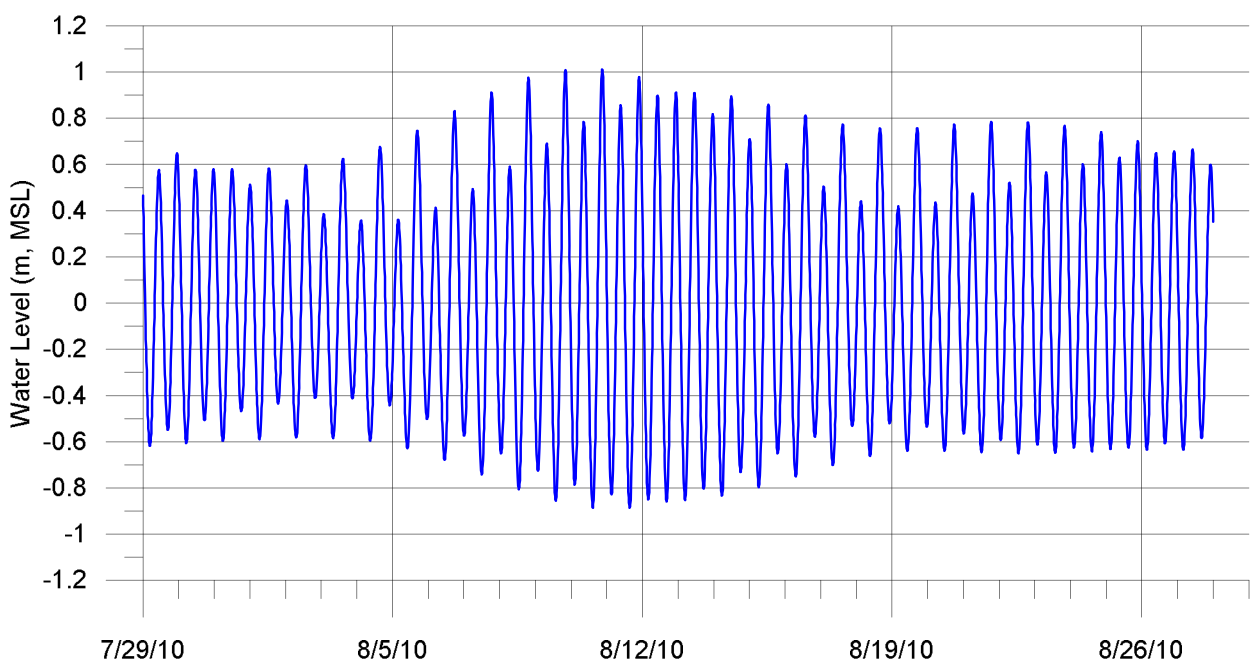


Figure 1: Computed tides at Southport for the simulation period analyzed herein.

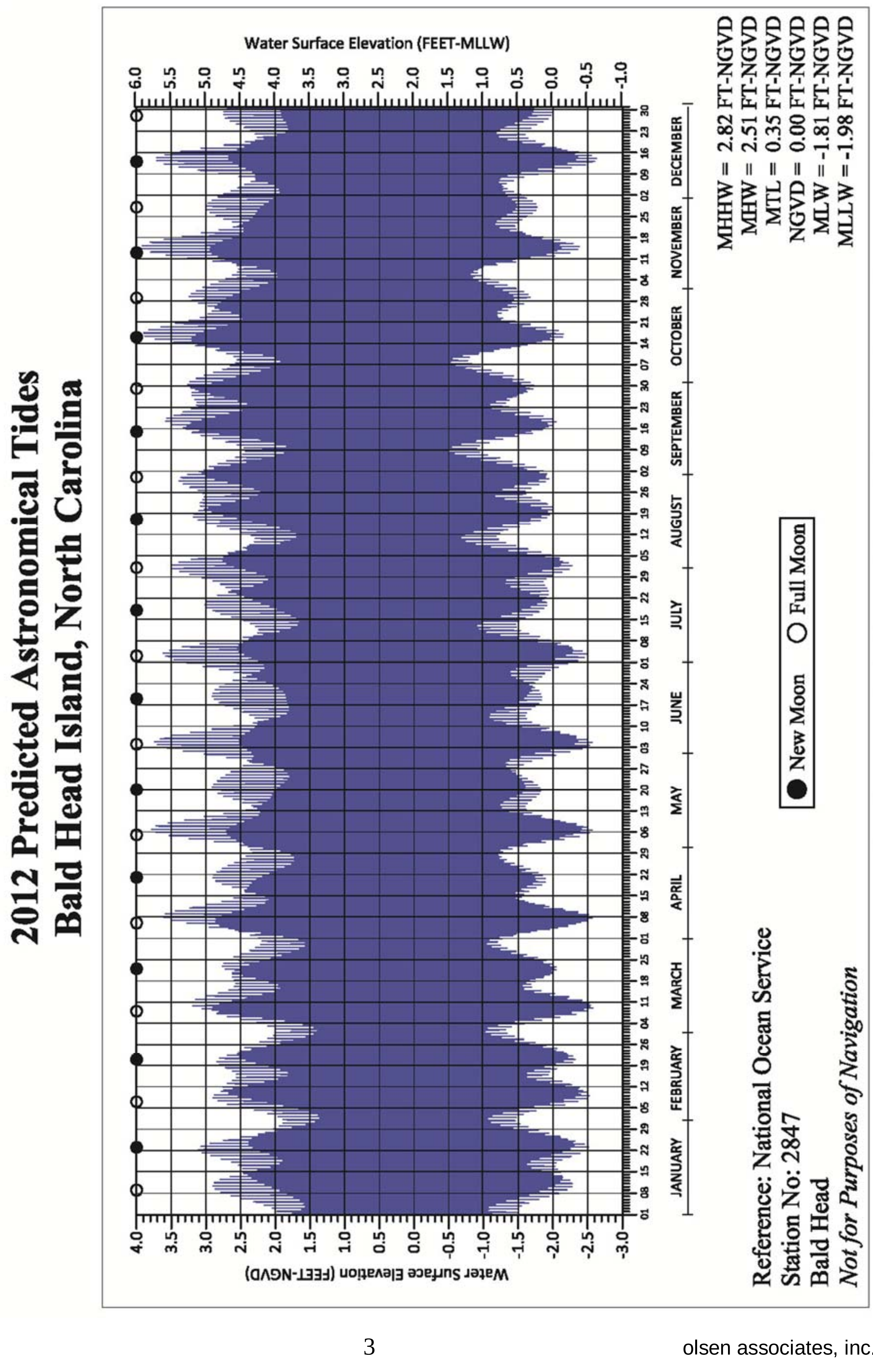


Figure 2: Predicted tides for 2012.

Figure 3 plots the residual tidal currents following the one-month simulation for the beach fill without terminal structure simulation. Residual flow is defined as the "net" flow that remains after subtracting all of the flood flow vectors from the ebb flow vectors for one lunar month. **Figure 4** comparatively plots residual flows computed under the with terminal groin condition. The model results indicate that large-scale patterns of residual flow are unchanged between alternatives. Locally, however, the terminal groin appears to accelerate ebb-directed residual flows immediately west of the structure. This is attributable to a reduction in flood tide velocity in the immediate lee/shadow of the terminal groin.

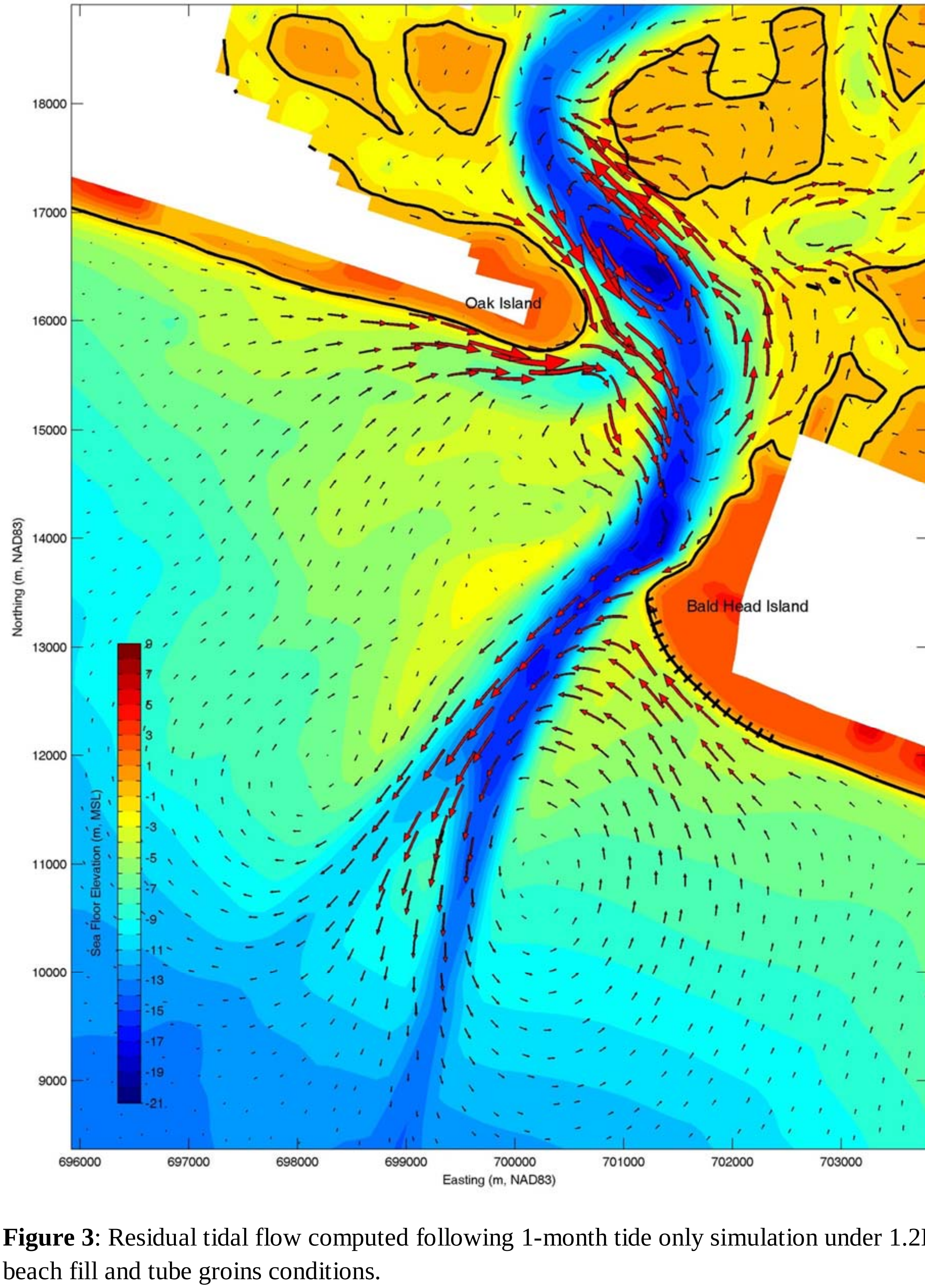


Figure 3: Residual tidal flow computed following 1-month tide only simulation under 1.2Mcy beach fill and tube groins conditions.

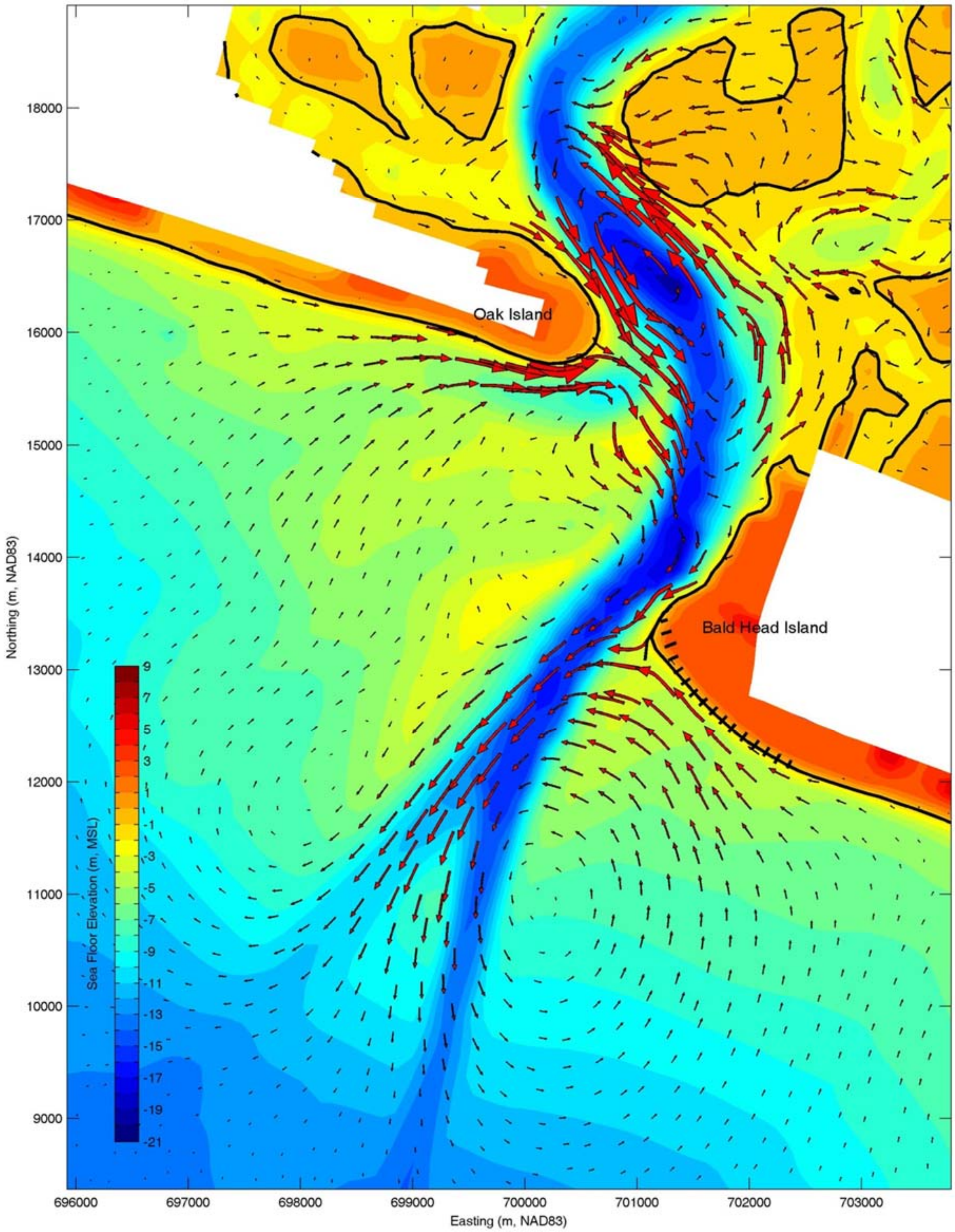


Figure 4: Residual tidal flow computed following 1-month tide only simulation under terminal groin with 1.2Mcy beach fill and tube groins conditions.

Figures 5 and **6** plot peak ebb tidal vectors and magnitudes under without- and with-terminal groin conditions, respectively. Comparison of the figures suggest the terminal groin most notably results in a modest decrease in ebb tidal velocities immediately offshore of the structure's seaward end near Bald Head Shoal. The magnitude of this decrease is on the order of 0.1 to 0.15 m/s and is limited to areas near the terminal groin. This decrease in flow velocity is partially offset by a small increase in the nearshore profile south of the groin field typically measuring less than 0.1 m/s. In terms of overall inlet hydraulics, the patterns of ebb tidal flow are not significantly altered following placement of the terminal groin.

Figures 7 and **8** plot peak flood tidal velocities and magnitudes under without- and with-terminal groin conditions, respectively. Comparison of the figures suggests that installation of the proposed terminal groin alters flood tides more significantly than the aforementioned ebb effects. This is predominantly due to (a) the reclamation of shoreline updrift and eastward of the terminal groin where with-project tides are non-existent, and (b) the redirection of flood tidal flow by the groin's seaward tip. The latter effect results in a small shadow zone in the lee of the terminal structure on a flood tide, which extends more-or-less to the limits of the navigation channel where the reduction in speed is negligible (<0.1 m/s). Peak reductions in flood tidal velocities on the order of about 0.5 m/s are identified very near the structure. The model results suggest that flood tidal velocities within, and slightly west of, the Bald Head Shoals I channel range will increase by about 0.1 m/s in response to the flow decrease computed adjacent to the proposed groin. Like the ebb tidal patterns within the inlet, the terminal structure is not predicted to have far-reaching effects on the tidal hydraulics of the inlet.

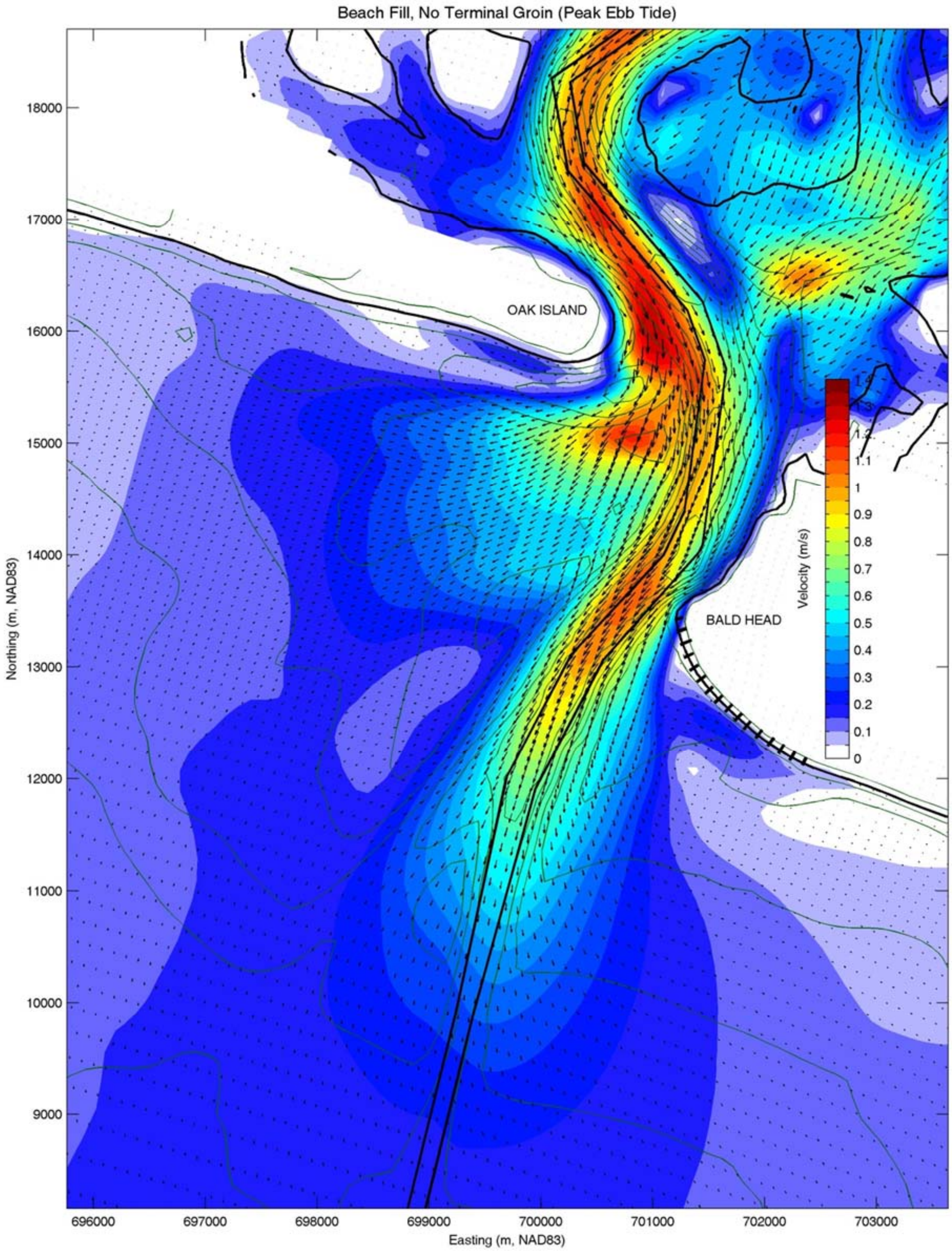


Figure 5: Peak ebb tidal flow computed following 1-month tide only simulation under 1.2Mcy beach fill and tube groins conditions.

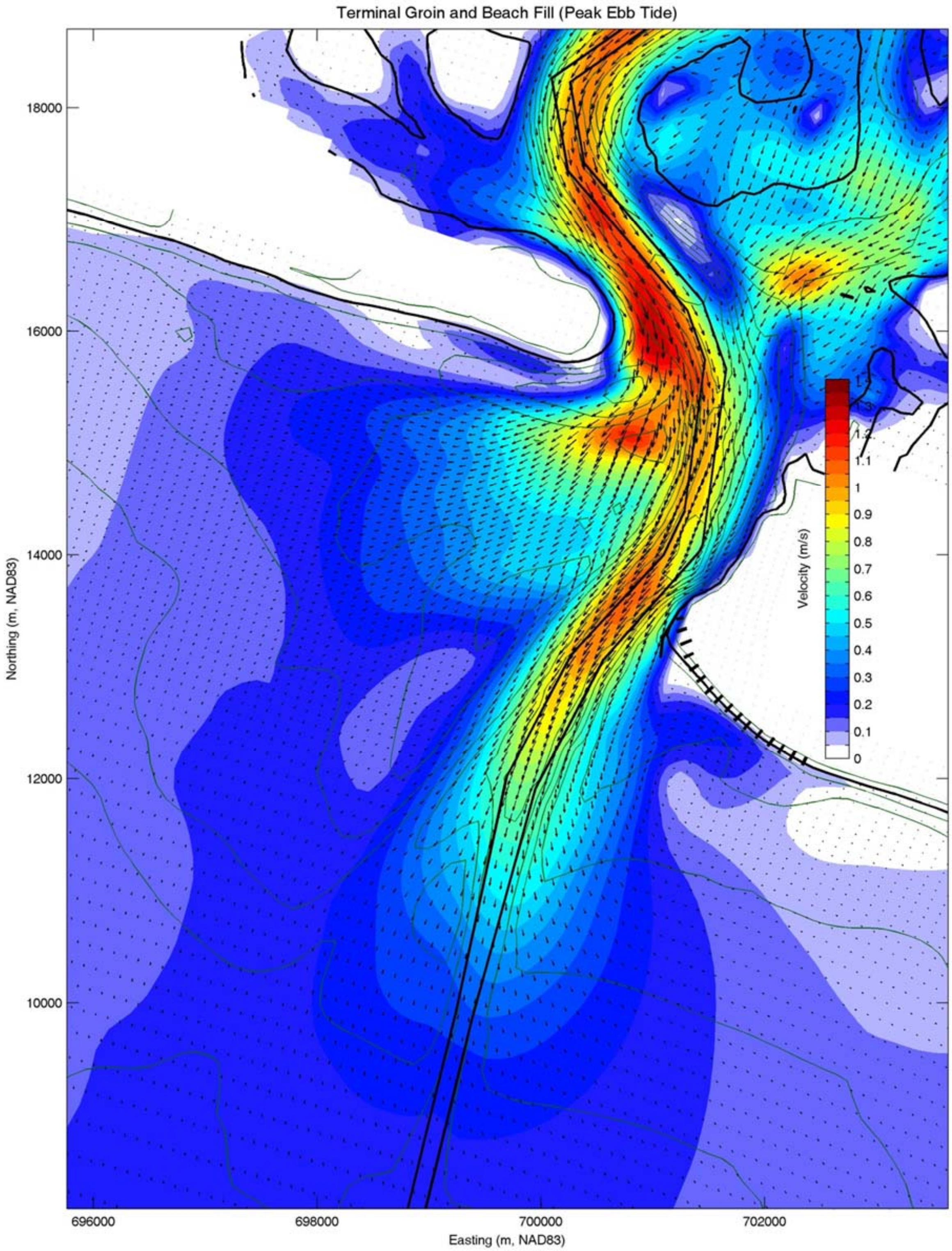


Figure 6: Peak ebb tidal flow computed following 1-month tide only simulation under terminal groin with 1.2Mcy beach fill and tube groins conditions.

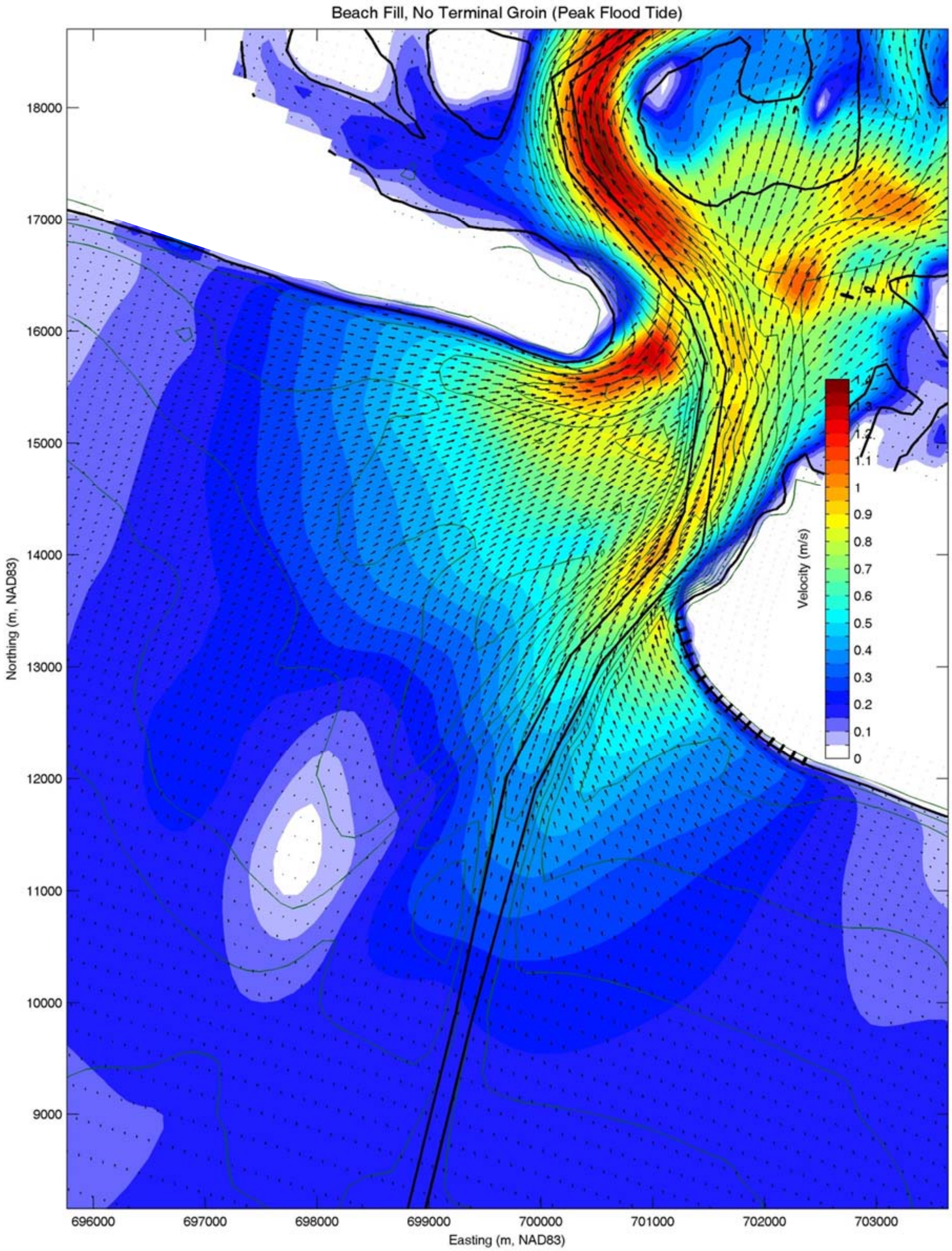


Figure 7: Peak flood tidal flow computed following 1-month tide only simulation under 1.2Mcy beach fill and tube groins conditions.

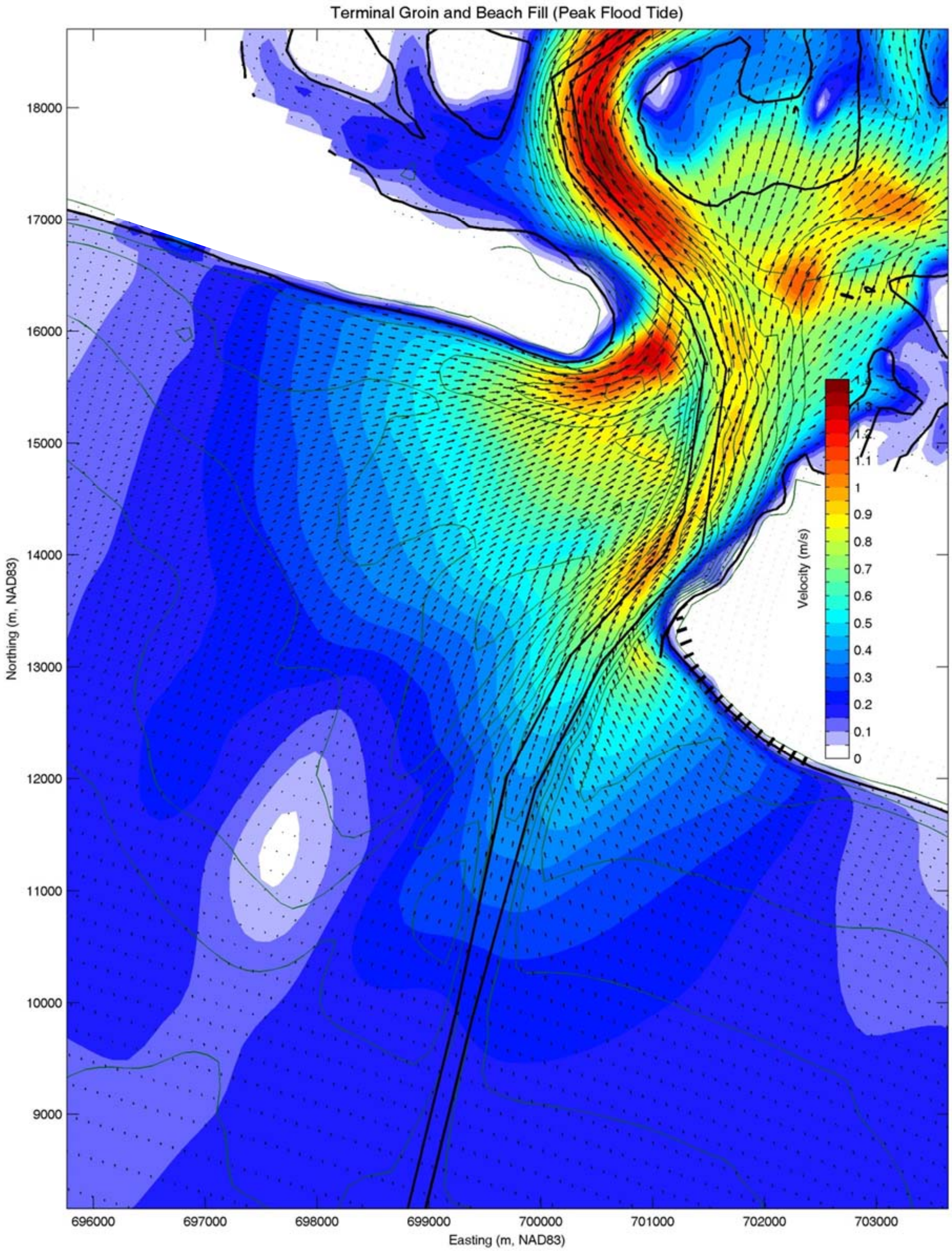


Figure 8: Peak flood tidal flow computed following 1-month tide only simulation under terminal groin with 1.2Mcy beach fill and tube groins conditions.

The hydrodynamic models were also utilized to evaluate potential changes in flow patterns which might affect the tidal transport of fish larvae from the Bald Head Island nearshore area to the inlet. Hypothetical larvae were simulated by deploying drogues at various nearshore and offshore locations within the model domain. Drogues were initially deployed at seven locations varying in distance from the inlet, see **Figure 9**. Drogue C was deployed the farthest from the inlet (about 2.1 miles east of the inlet) and is located in the nearshore in an area where flood tidal currents are respectively weak. Based on the model results shown in **Figure 7**, drogue C is located along the edge of influence the flood tidal influence where peak velocities are predicted to be less than 0.2 m/s. Drogues D through G were initially placed along a shore perpendicular azimuth beginning east of the groin field and extending slightly more than 1,500 meters offshore.

At each location, the drogues were deployed twice during the 30-day simulation. The first deployment occurred at time step one in the model which corresponds to a neap tide condition – this time step equates to 29 July 2010 00:00 in **Figure 1**. Following deployment, these drogues were tracked throughout the entire model simulation. Additional drogues were deployed at each location and tracked beginning at a time step equivalent to 17:50 hours on 10 August 2010. This time step reflects conditions present during the simulated spring tide range. The locations of drogue deployments were identical between neap and spring simulations, and deployments were timed to roughly correspond with a mid-tide. In addition to the water level data presented in **Figure 1**, water levels during the deployment are indicated on each result illustration presented below.

The path and duration of travel for each drogue was calculated and compared both with and without the terminal groin. It is assumed that once a particle passes west of the western tip of Bald Head Island and enters the inlet, it enters a hydraulic regime which is dominated by river flows, tidal currents, and pressure fields which operate well outside of the influence of the terminal groin as noted in the above discussion. **Figure 10** demonstrates the extreme variability in drogue tracks once a particle leaves the nearshore zone and enters the influence of the inlet. The figure plots the movements of all drogues for the entire simulation. For reference, **Figure**

11 plots the path of drogue A for the entire monitoring period. The particle pathway suggests that once the drogue enters the inlet it travels throughout the dominant tidal range of the inlet traversing a path through the estuary, about 7-8 miles upriver, and into the open ocean along the ebb tidal platform.

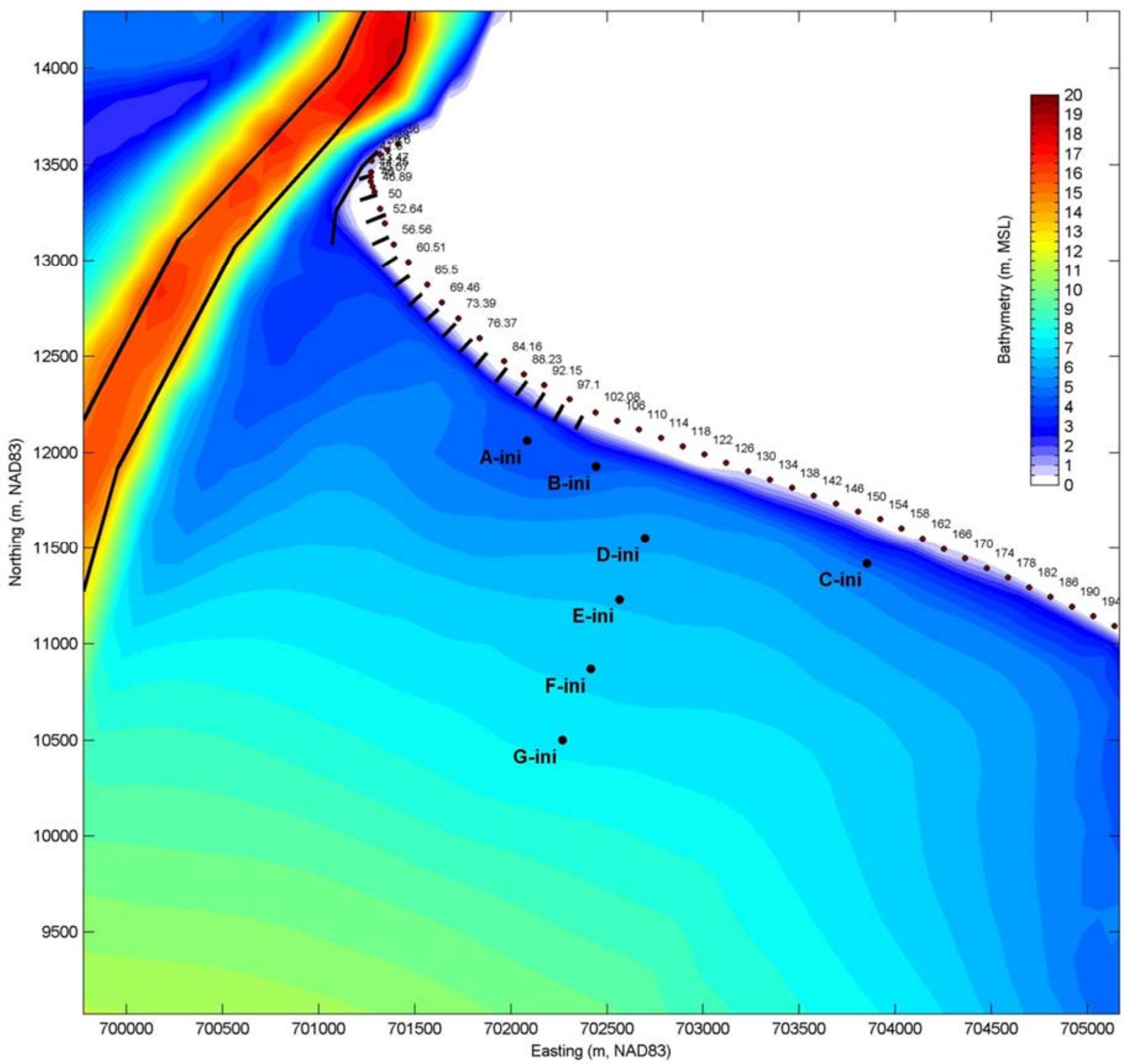


Figure 9: Initial deployment of each drogue tacked for this analysis.

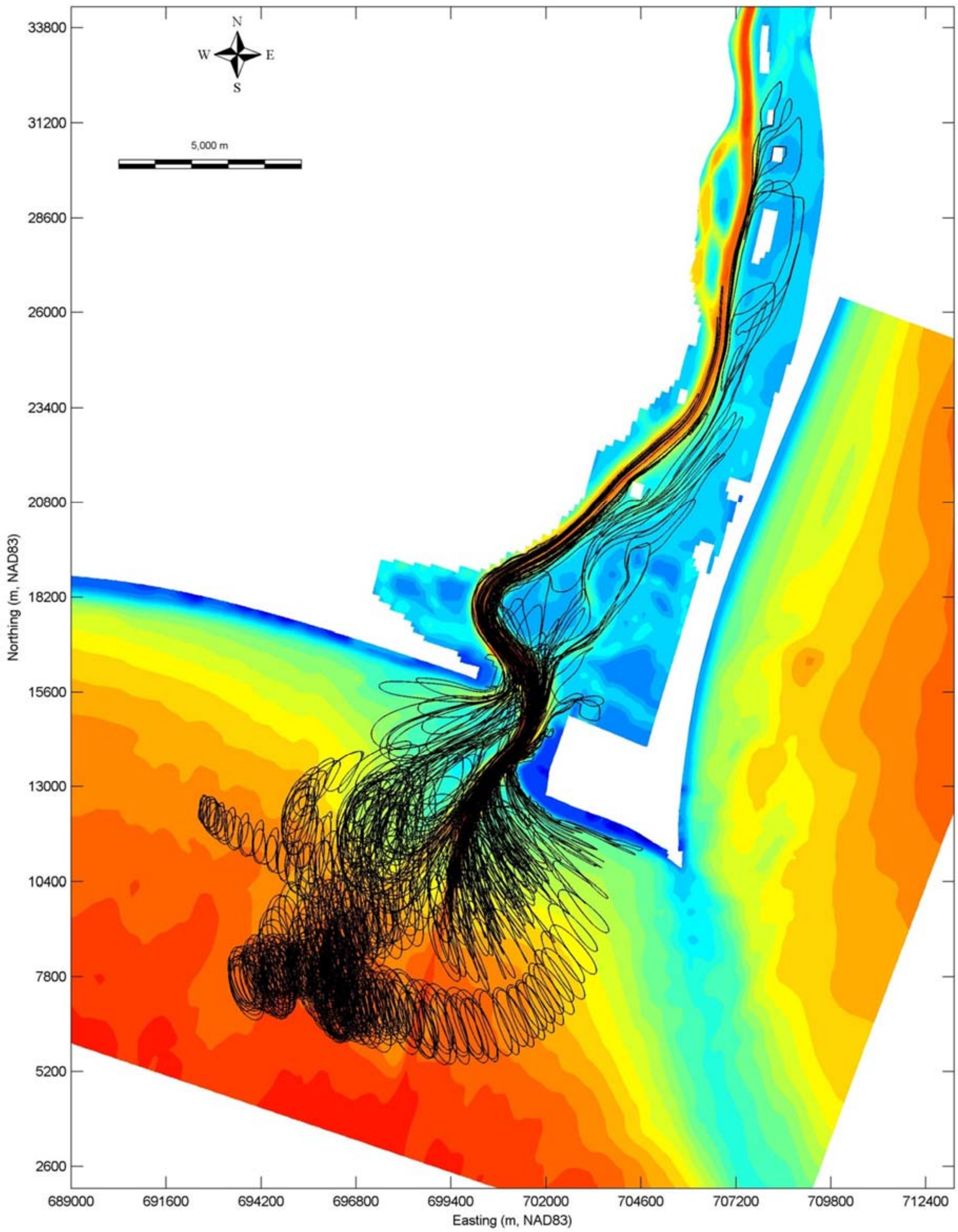


Figure 10: All drogue tracks for the entire monitoring period.

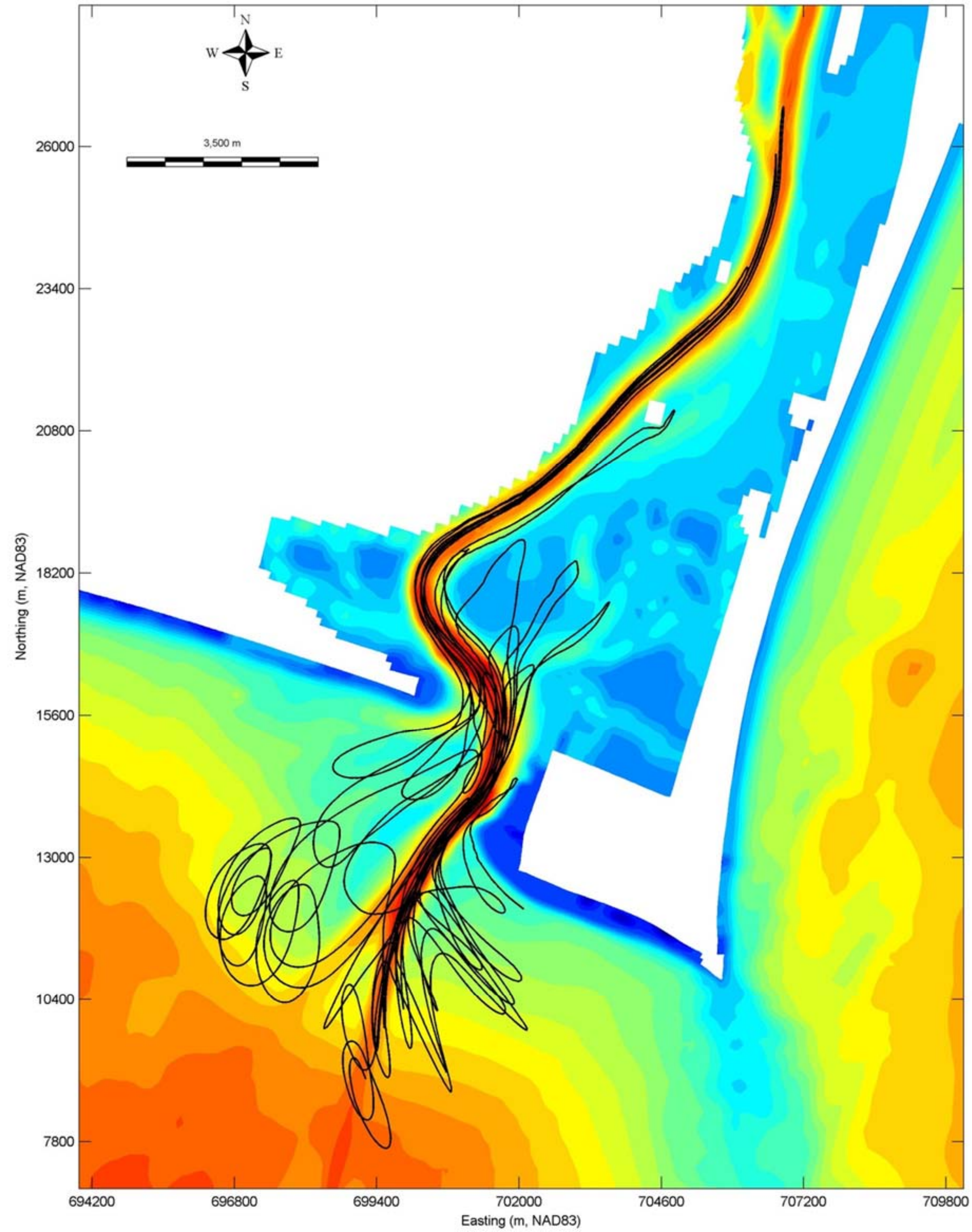


Figure 11: Path of drogue 'A' for the entire monitoring period.

Summary results for each drogue are tabulated in **Tables 1** and **2** for neap and spring tide drogue releases, respectively. The tabular results indicate the total number of model time steps required for the drogue to reach the inlet along with the total travel time, in hours. Each time step represents 0.2 minutes, or 12 seconds in the numerical model. The difference between the beach fill only and with terminal groin travel times is additionally noted. Negative times suggest longer travel times under the with terminal groin condition.

Table 1: Drogue travel times when released during a neap tide.

Drogue ID	Fill Only		Terminal Groin w/ Fill		Difference
	No. Time Steps	Time (hrs)	Time Steps	Time (hrs)	(hrs)
A	1,840	6.1	1,855	6.2	-0.05
B	1,975	6.6	1,990	6.6	-0.05
C	9,075	30.3	9,360	31.2	-0.9
D	2,385	8.0	2,425	8.1	-0.1
E	2,620	8.7	2,625	8.8	-0.02
F	2,920	9.7	2,920	9.7	0.0
G	5,820	19.4	5,800	19.3	0.1

Table 2: Drogue travel times when released during a spring tide.

Drogue ID	Fill Only		Terminal Groin w/ Fill		Difference
	No. Time Steps	Time (hrs)	Time Steps	Time (hrs)	(hrs)
A	290	1.0	330	1.1	-0.1
B	455	1.5	580	1.9	-0.4
C	10,300	34.3	17,710	59.0	-24.7
D	730	2.4	950	3.2	-0.7
E	3,070	10.2	3,320	11.1	-0.8
F	3,520	11.7	3,600	12.0	-0.3
G	3,780	12.6	3,820	12.7	-0.1

The tracking results suggest that the travel time from the nearshore off Bald Head Island to the inlet is, generally speaking, very modestly slowed following the construction of a beach fill with a terminal groin. There were two exceptions to this finding whereby drogue releases F and G on a neap tide experienced either no change or a slight decrease in travel time following groin construction. Typically drogues released during a spring tide were slowed slightly more than those released during a neap tide. In either case, with the exception of one outlier (drogue C), these differences were very modest. The data suggest that, on average, drogue travel was slowed by about 0.16 hours (9.6 minutes) for the neap tide releases. For the spring tide releases, travel time was slowed by an average of about 3.9 hours under with groin conditions. The larger spring tide difference is wholly attributable to drogue C initially located at the eastern boundary of tidal influence. This drogue tended to slow primarily near the intertidal beach under with terminal groin conditions resulting in an abnormally large delay of about 24.7 hours for drogue C. Possible reasons for the performance of drogue C on a spring tide are discussed below.

Neap Tide Releases. **Figures 12** through **18** compare individual drogue tracks computed under with and without terminal groin conditions for drogues released during a neap tide condition. The time required to reach the inlet is noted on each figure along with the tidal phase at Southport during the period of measurement. Travel times to the inlet varied between 6.1 and 31.2 hours typically corresponding with initial distance from the inlet. Differences in travel time with and without the terminal groin varied between 3 and 57 minutes and also typically correlate with the distance from the inlet. As previously stated, the average time difference potentially attributable to the terminal groin was less than 10 minutes indicating the structure is not expected to significantly hinder the timely ability of a nearshore particle to reach the inlet. Travel directions between with and without groin simulations typically deviated only near the inlet itself as flows are diverted both around (and weakly through) the pre-filled, porous terminal groin rather than being carried directly around the sandy shoreline of the Point of Bald Head Island.

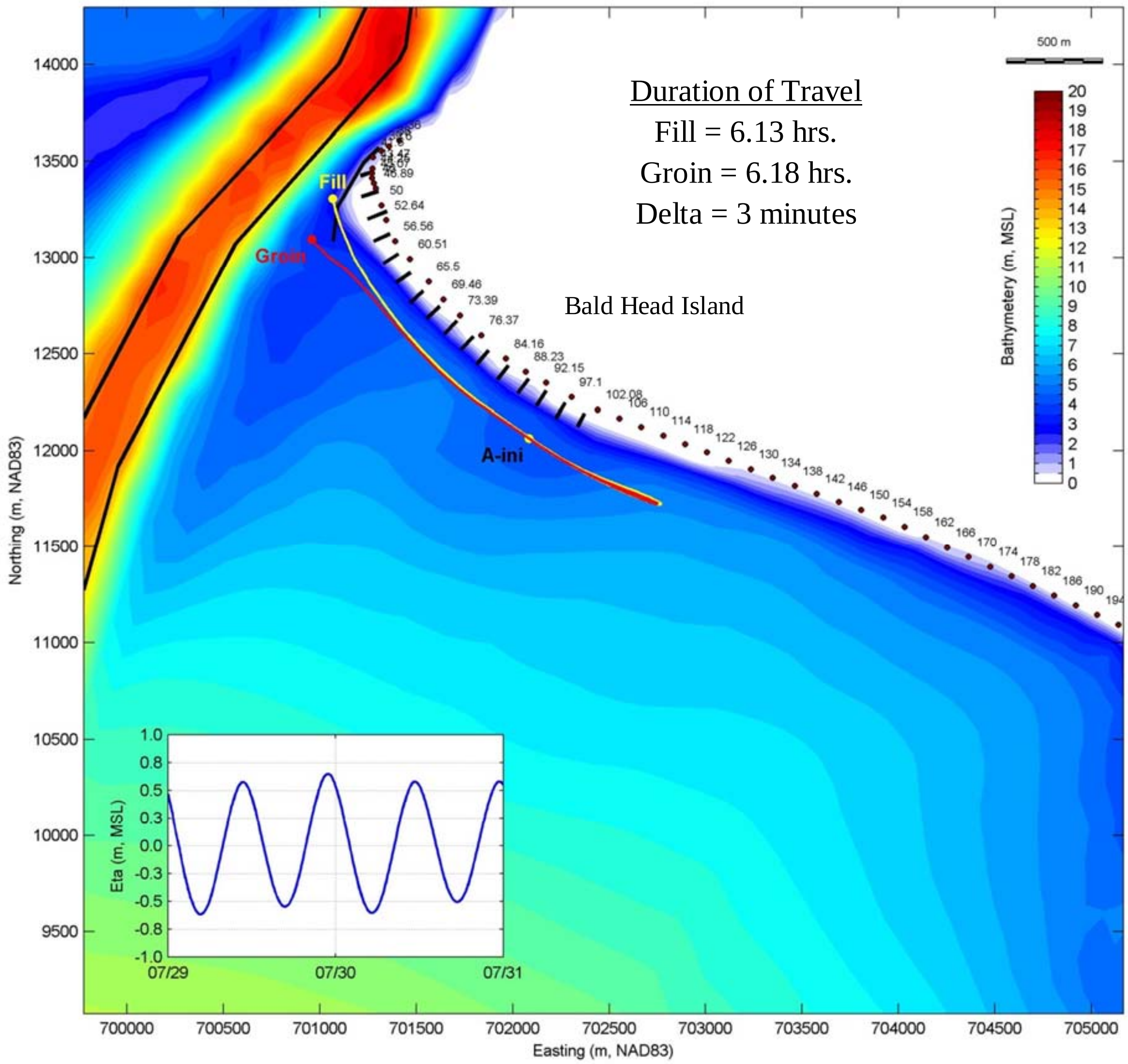


Figure 12: Drogue track A from deployment to inlet, with and without the terminal groin.

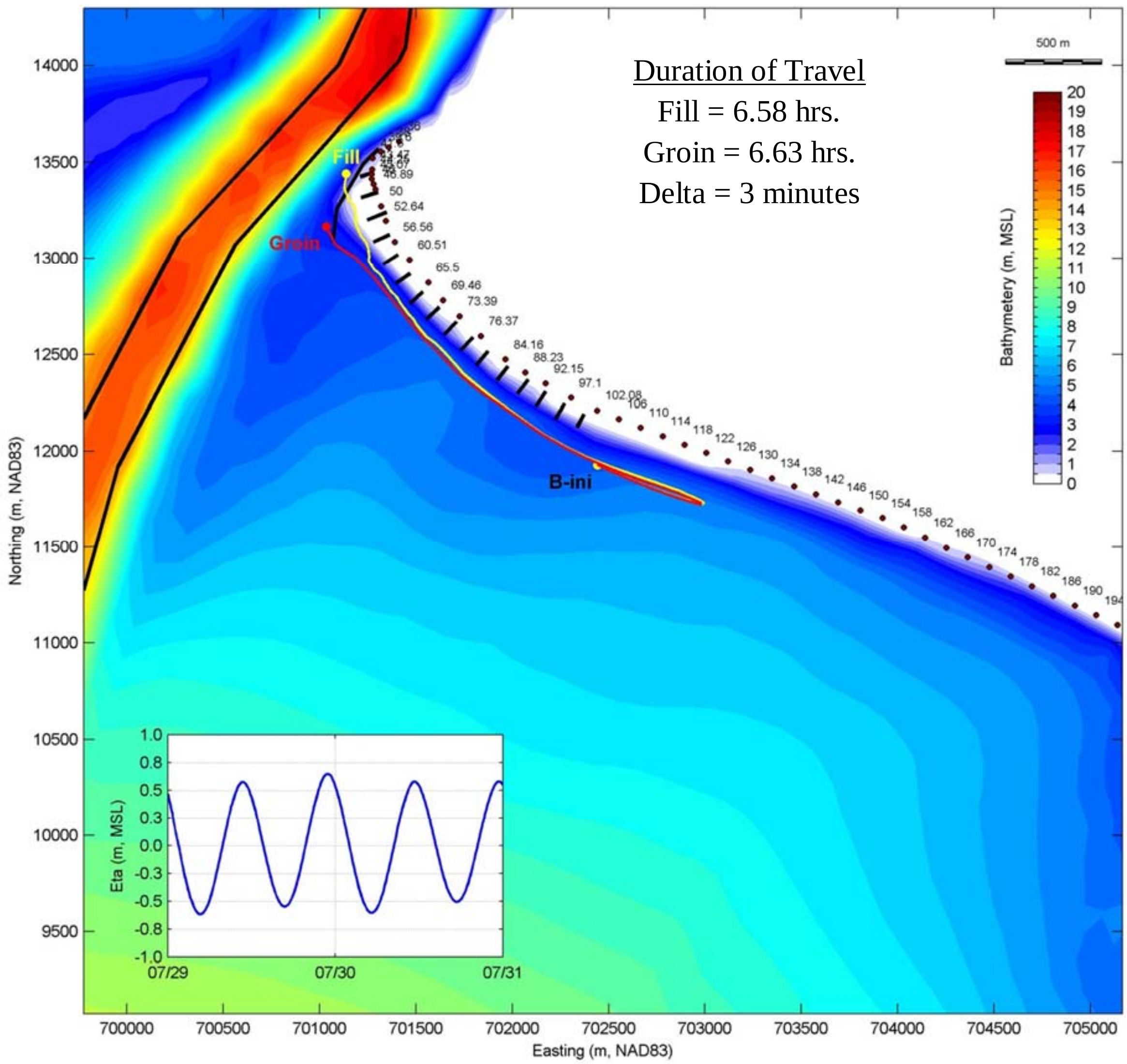


Figure 13: Drogue track B from neap tide deployment to inlet, with and without the terminal groin.

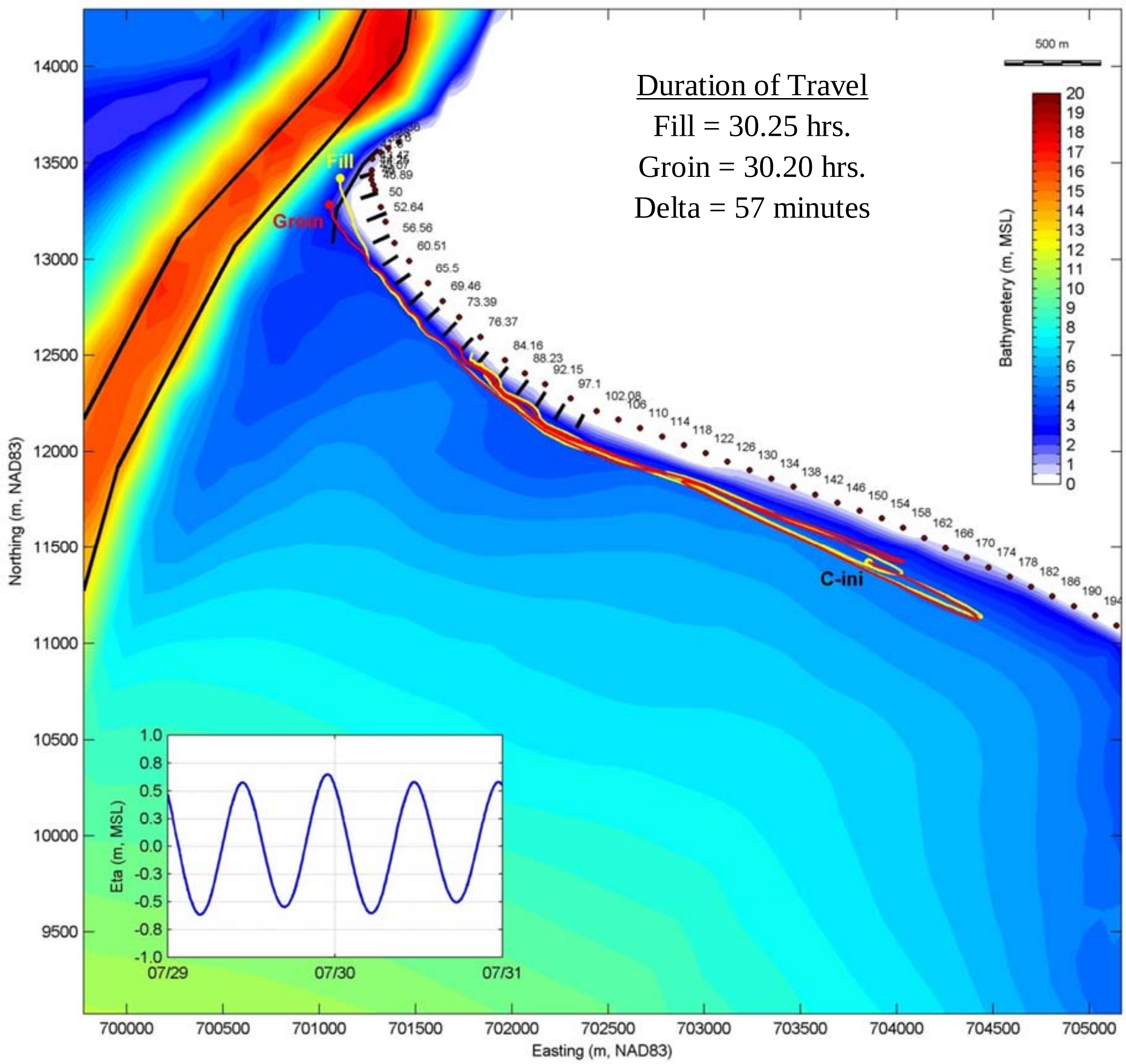


Figure 14: Drogue track C from neap tide deployment to inlet, with and without the terminal groin.

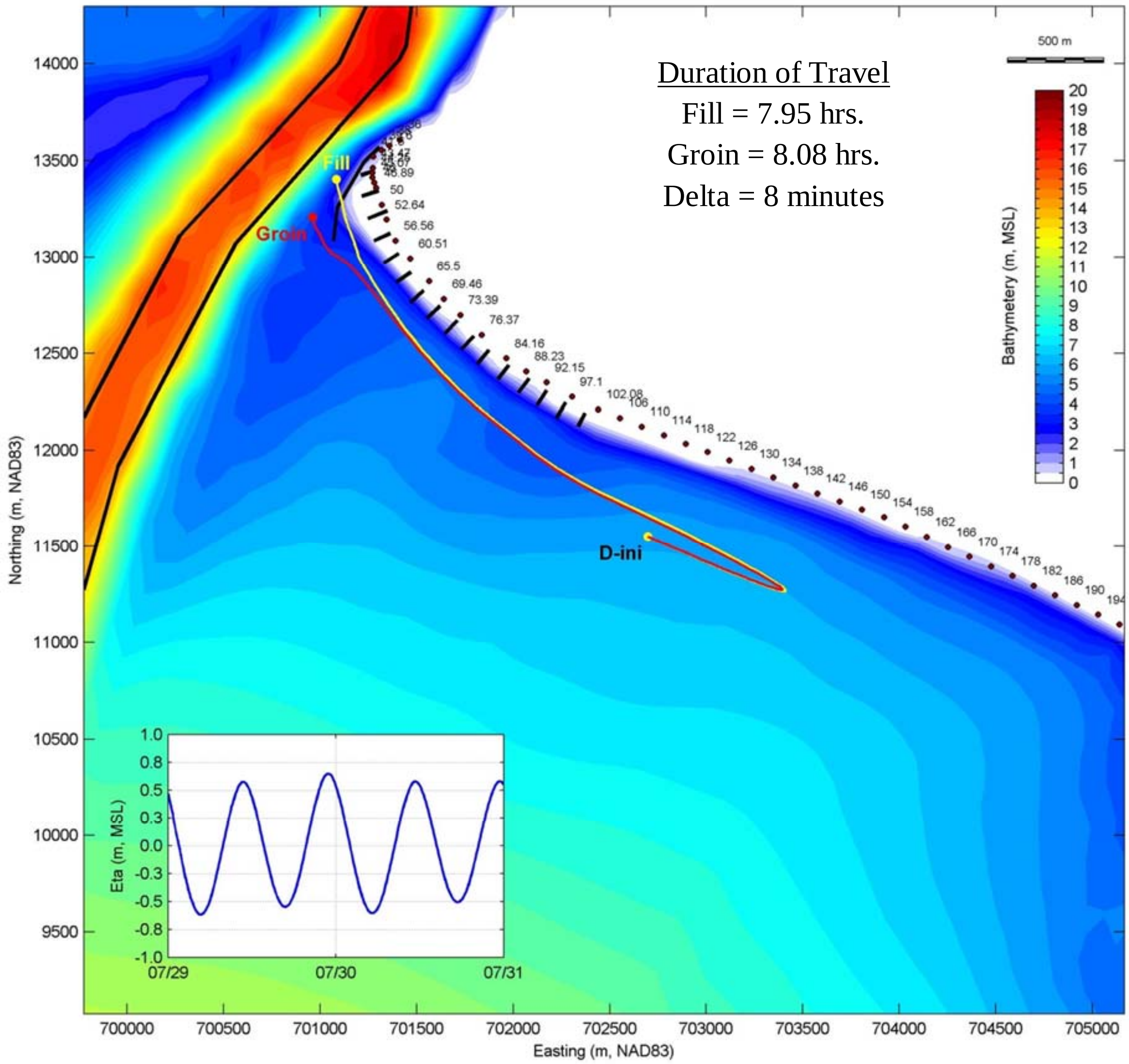


Figure 15: Drogue track D from neap tide deployment to inlet, with and without the terminal groin.

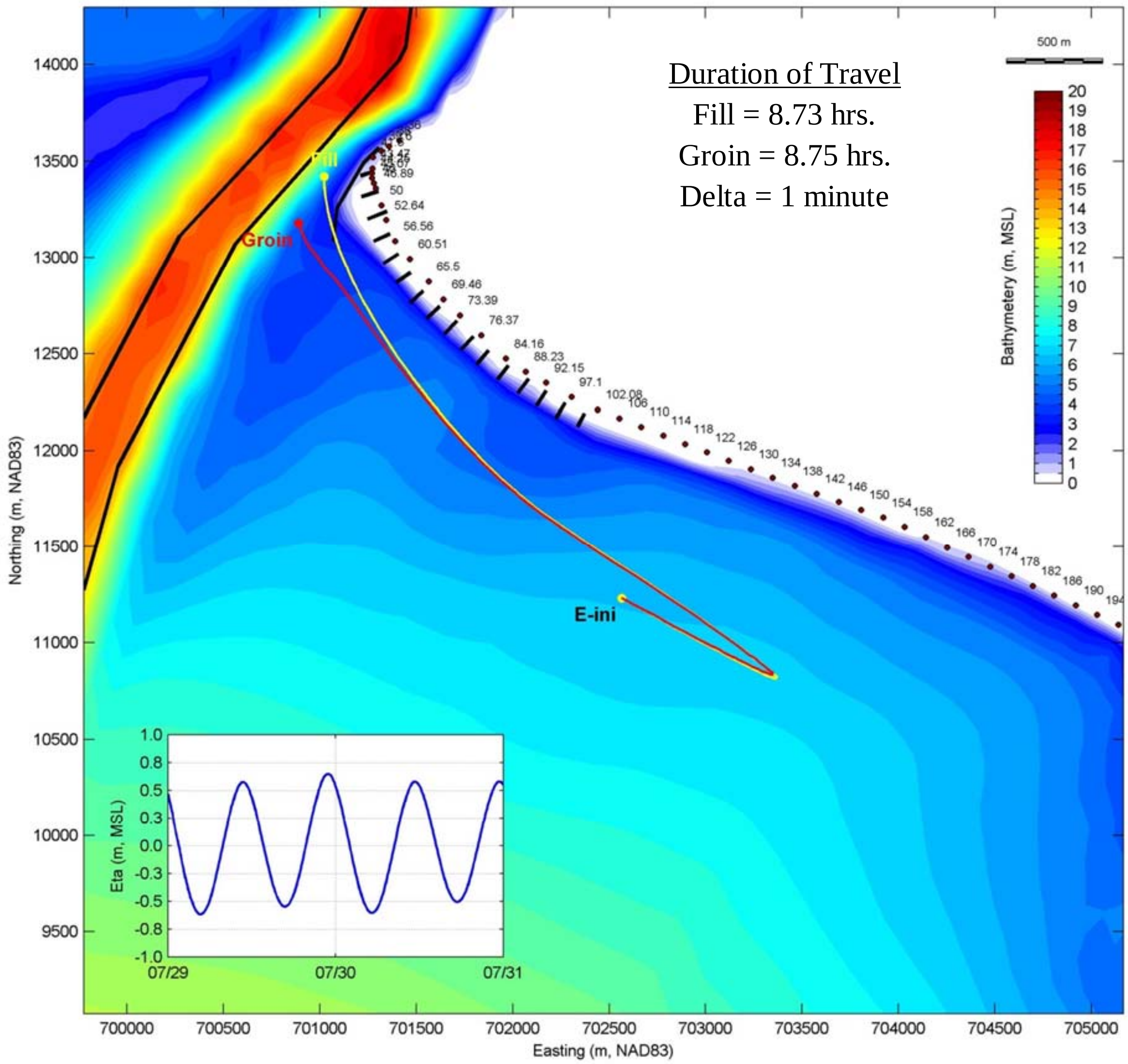


Figure 16: Drogue track E from neap tide deployment to inlet, with and without the terminal groin.

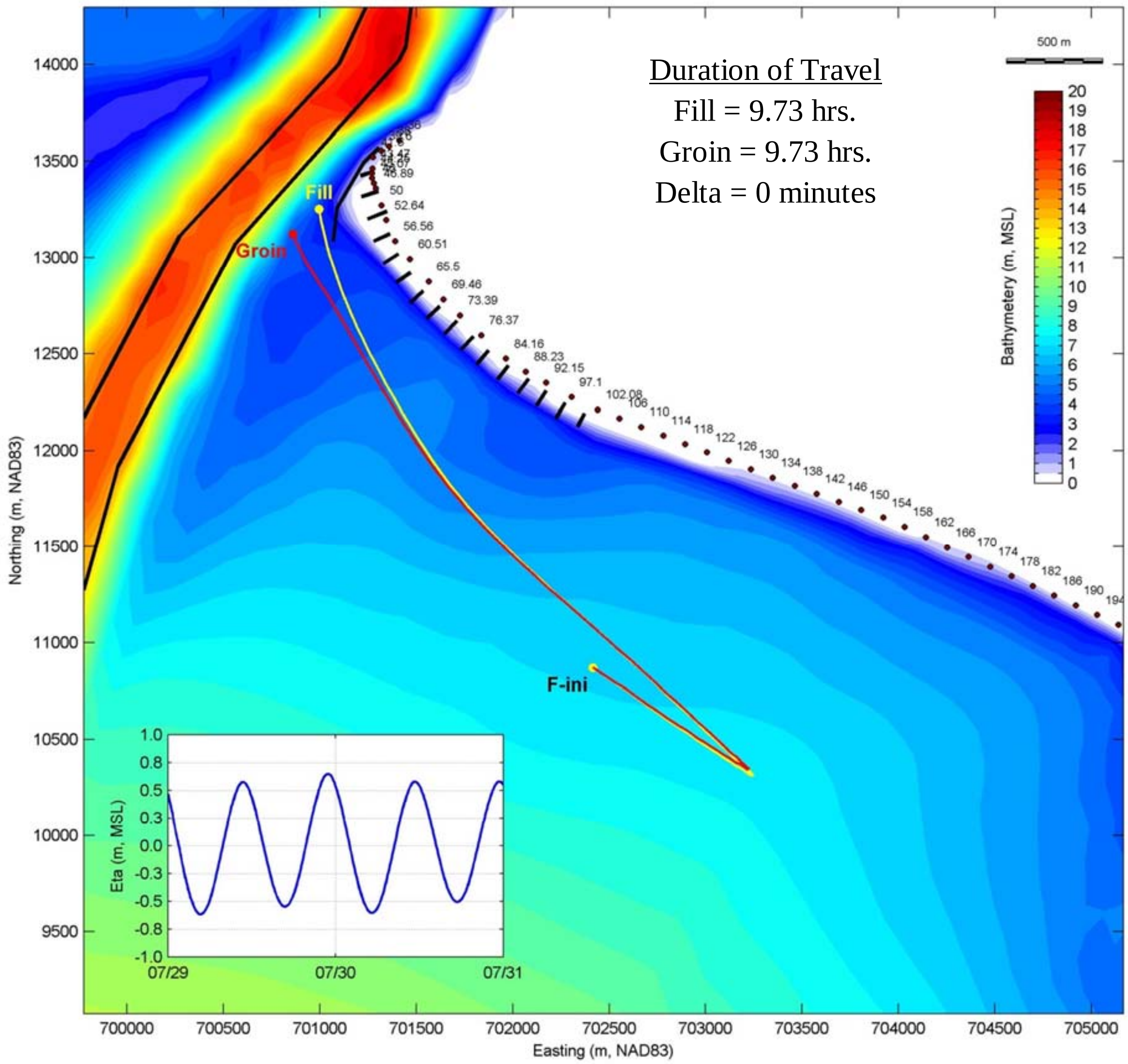


Figure 17: Drogue track F from neap tide deployment to inlet, with and without the terminal groin.

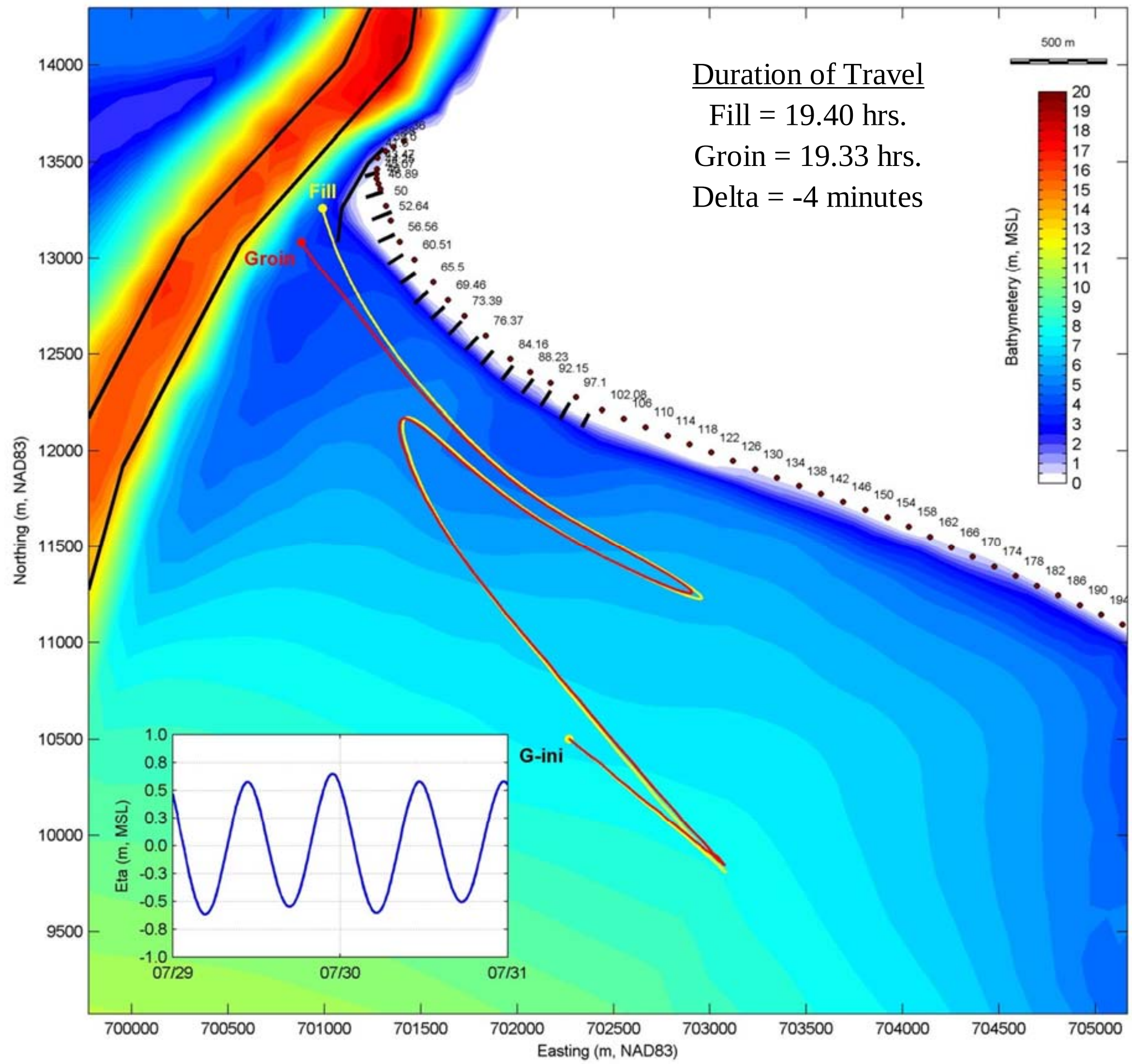


Figure 18: Drogue track G from neap tide deployment to inlet, with and without the terminal groin.

Spring Tide Releases. **Figures 19** through **25** compare individual drogue tracks computed under with and without terminal groin conditions for drogues released during a spring tide condition. The time required to reach the inlet is noted on each figure along with the tidal phase computed at Southport during the period of measurement. Travel times to the inlet varied between 1 and 59 hours again varying with respect to the distance from the inlet. Differences in travel time for with and without groin conditions varied between 8 minutes and 24.7 hours. Excluding that of drogue C (24.7 hours) differences in transit time following terminal structure construction range between 8 and 50 minutes, averaging about 25.2 minutes.

The large difference in transit time for drogue C is attributable to the fact that the particle managed to migrate onto the intertidal beach and effectively become 'stranded' significantly slowing the drouge's motion for a number of tidal oscillations – observable as the drogue path travels very near to the shoreline in the with groin scenario (see **Figure 21**). This stranding occurred east of station 130+00 where significant differences in the nearshore bathymetric profile are included in the model domain. These bathymetric variations are the result of differences in the beach fill sectional density as the beach fill is less voluminous to nonexistent here under without terminal groin conditions. The changes in travel time and particle path here are in response to nearshore bathymetric variations (i.e., less fill allowed the drogue to travel closer to shore and move more slowly) rather than hydraulic influences of the terminal structure. Once clear of this section of shoreline (west of station 130+00), the particles follow a similar path and timetable into the inlet.

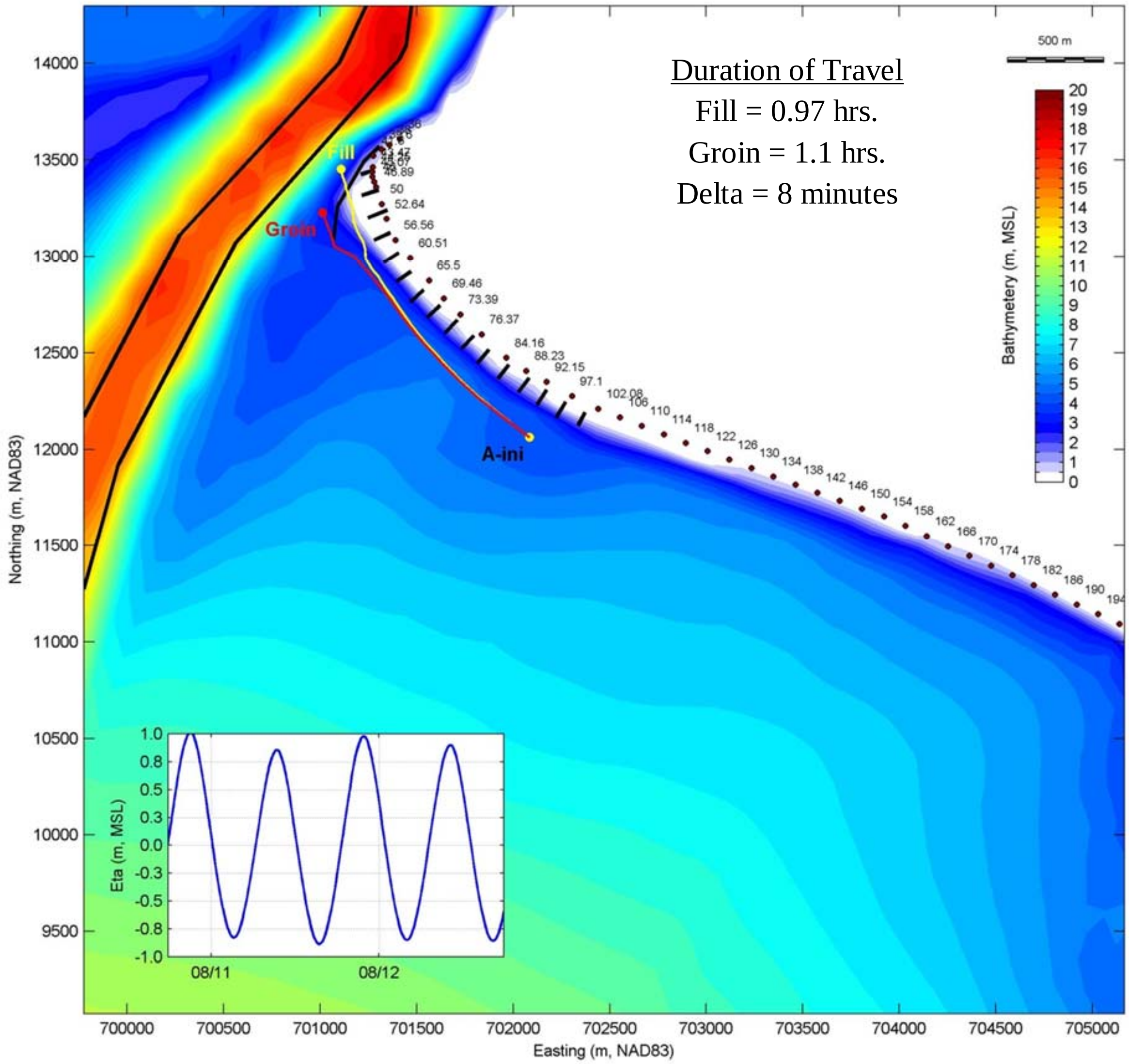


Figure 19: Drogue track A from spring tide deployment to inlet, with and without the terminal groin.

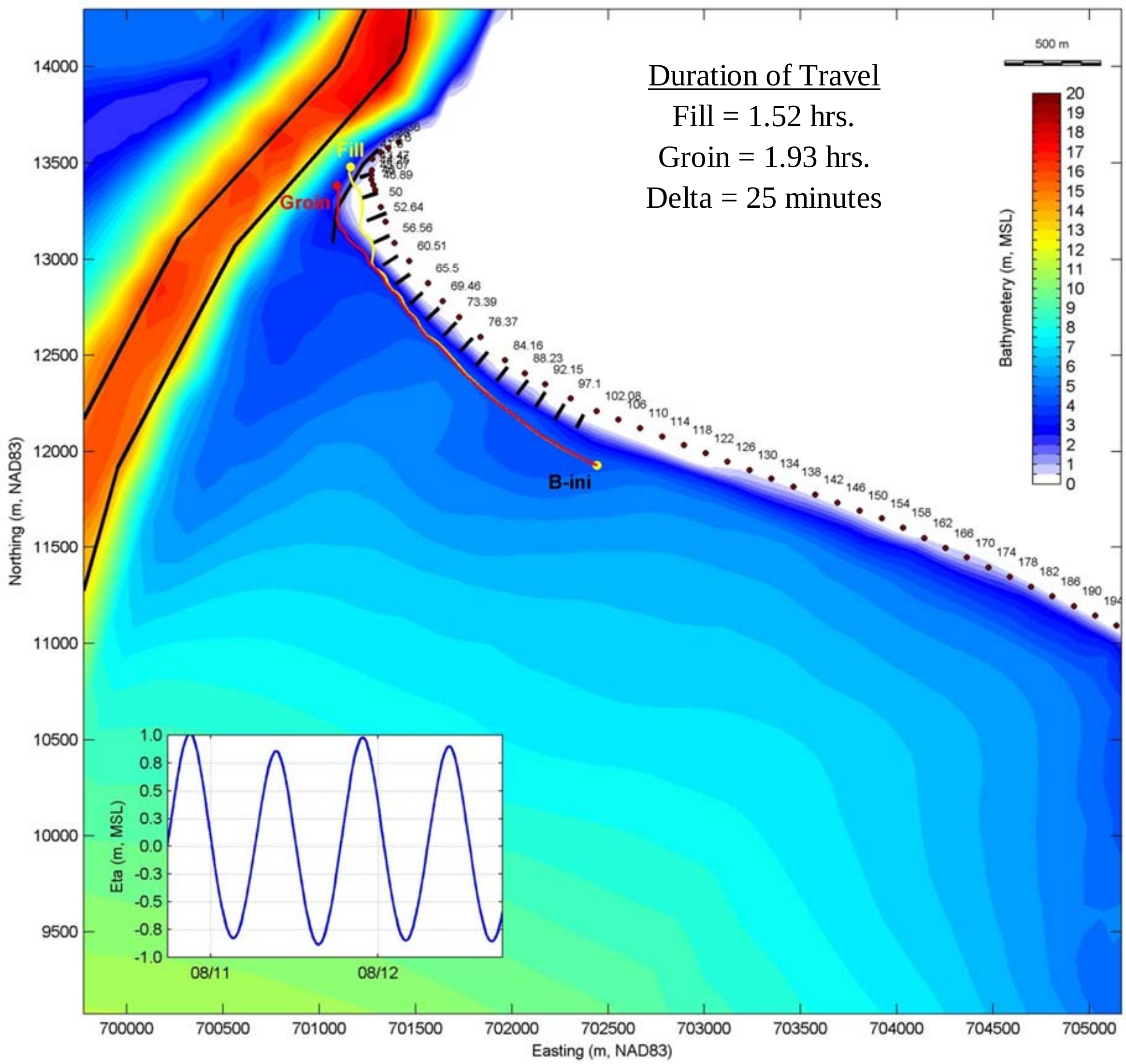


Figure 20: Drogue track B from spring tide deployment to inlet, with and without the terminal groin.

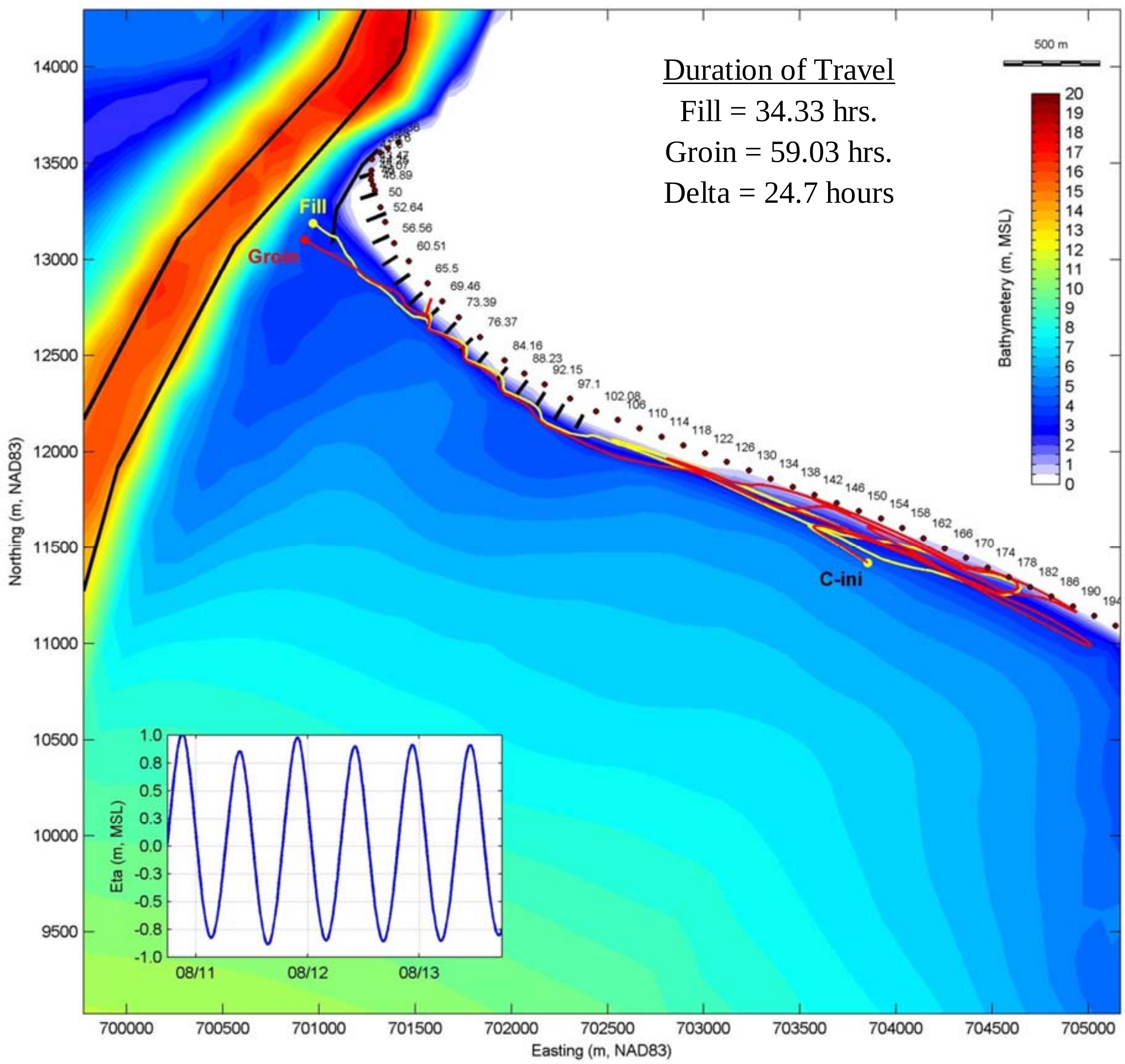


Figure 21: Drogue track C from spring tide deployment to inlet, with and without the terminal groin.

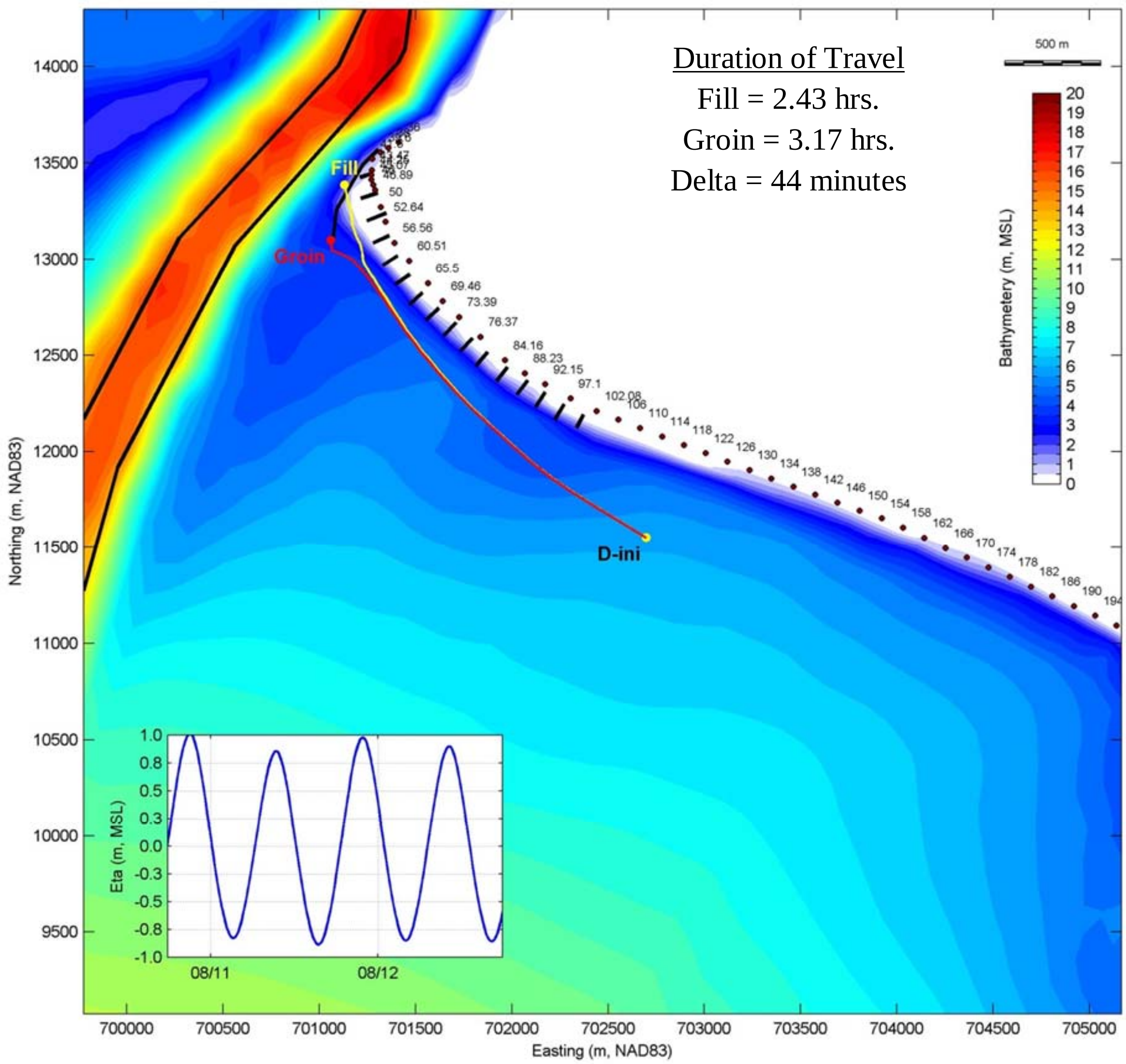


Figure 22: Drogue track D from spring tide deployment to inlet, with and without the terminal groin.

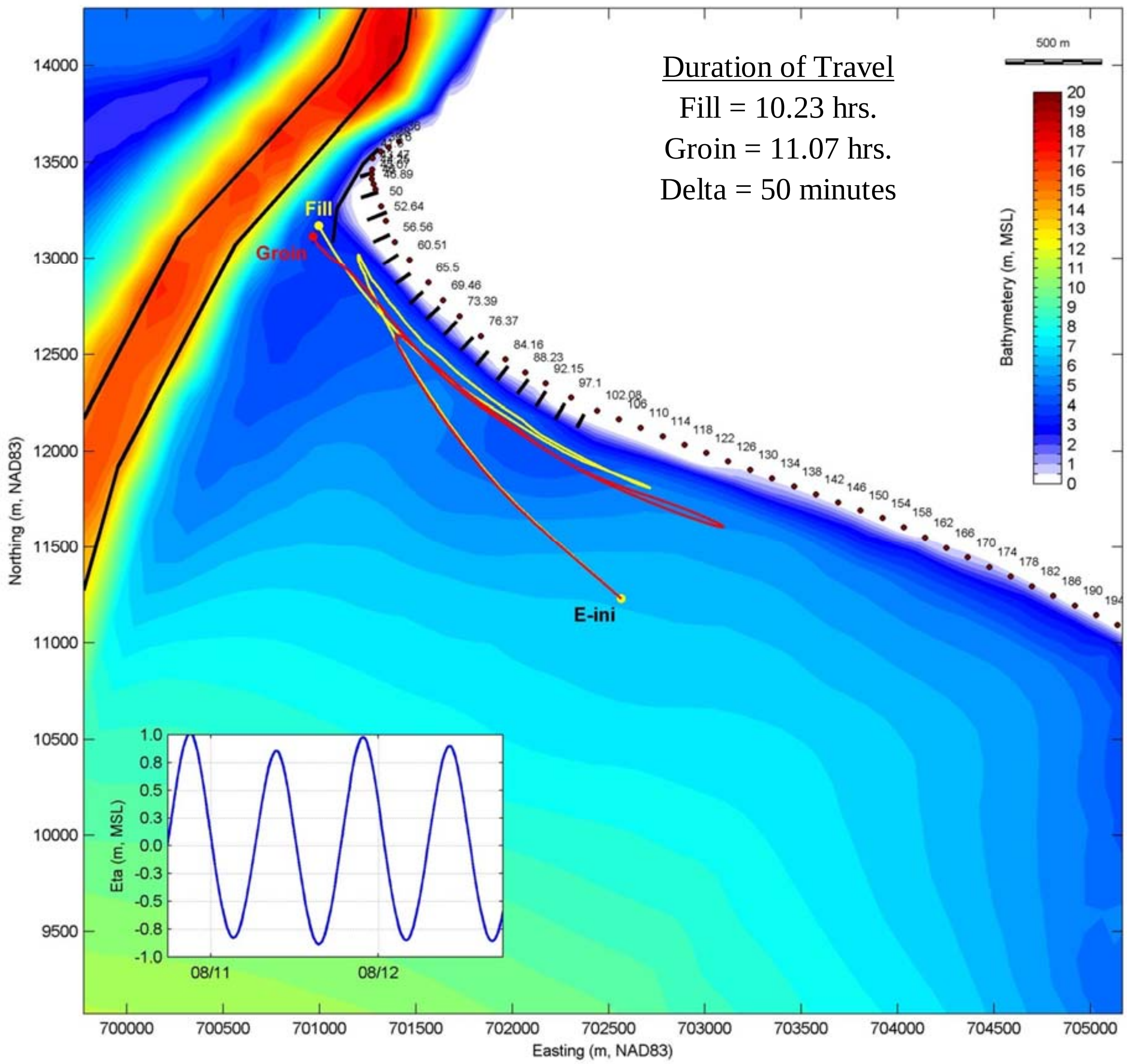


Figure 23: Drogue track E from spring tide deployment to inlet, with and without the terminal groin.

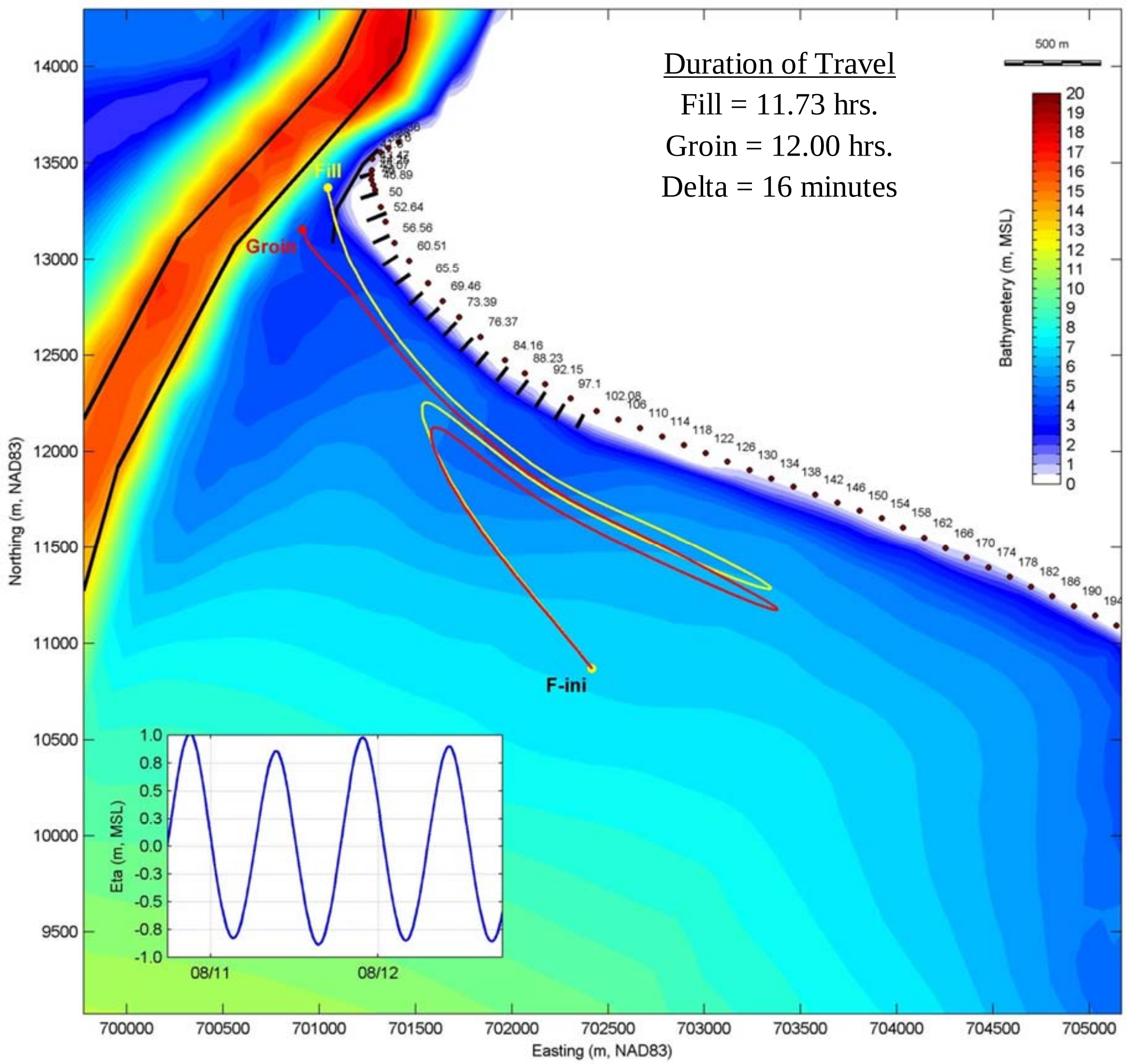


Figure 24: Drogue track F from spring tide deployment to inlet, with and without the terminal groin.

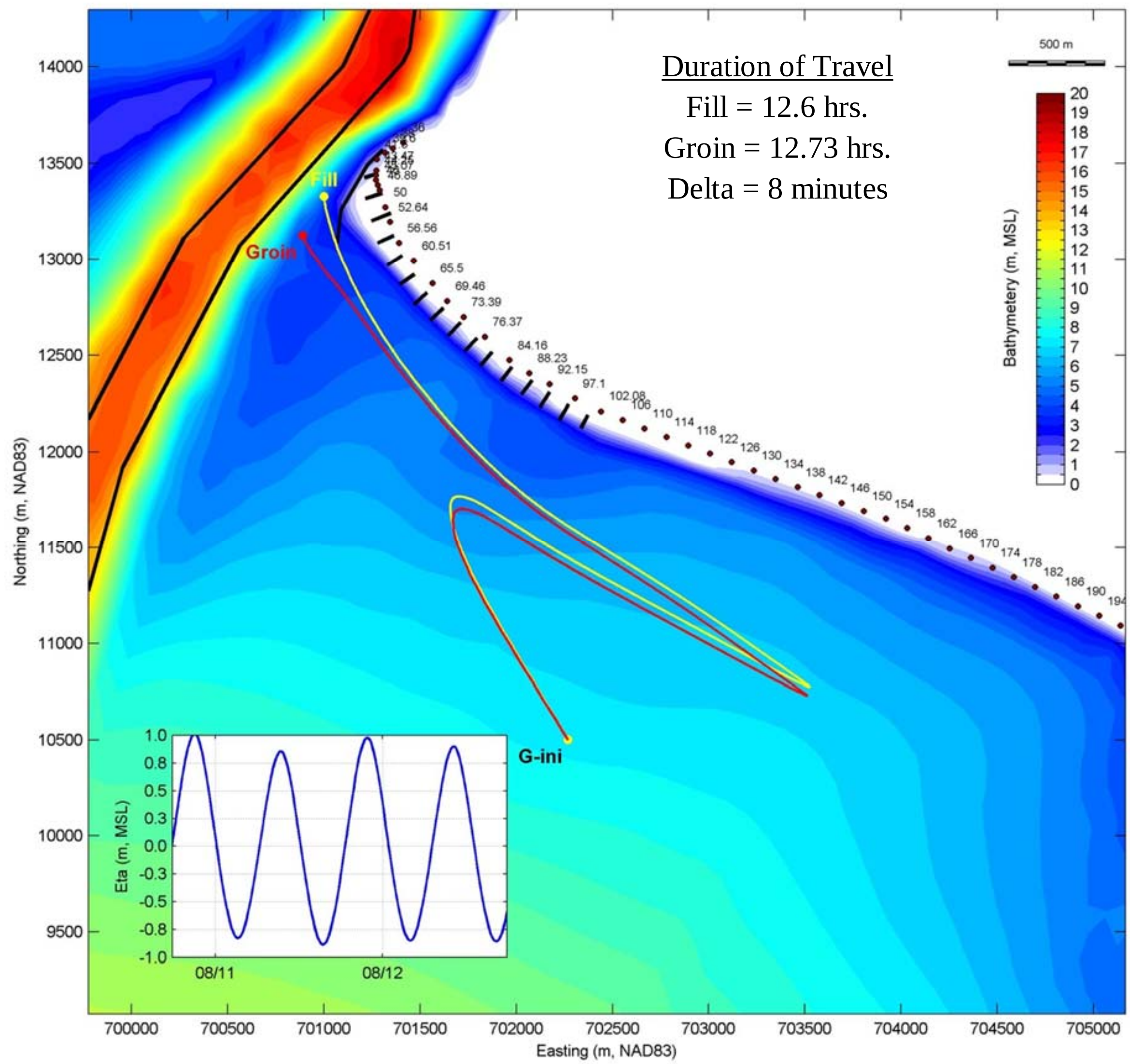


Figure 25: Drogue track G from spring tide deployment to inlet, with and without the terminal groin.

Particle Tracking. The Deflt3D particle tracking model was used to simulate the instantaneous release of a set number of particles contained in a specified amount of tracking agent. The particle tracking model is run independently of the hydrodynamic model and utilizes the hydrodynamic model results as input. Like the drogue tracking exercises, tracer particles are conservative in that there is no decay over time. Tracer particles were released twice, at time steps representing both spring and neap tide conditions and tracked throughout the remaining simulation run. The timing of tracer deployment was the same as used for the drogue analyses. The total number of particles was specified at 10,000 and the total mass of tracer was 2 kg. Particles were released east of the groin field and are represented and mapped as concentrations.

Neap Tide Condition. **Figures 26** through **33** plot the particle distribution at various intervals in time following neap tide insertion. In each figure, the beach fill only and the fill with terminal groin alternatives are plotted side by side one another in order to yield a comparative view at a given time step. The figures plot only the particle positions through the fifth day following initial release given that by day five the particles are quite well distributed throughout the predominantly tidally influenced areas of the model. The tidal stage is indicated by the red line on the water level plot in the upper left corner of each figure. The dominant current direction (ebb or flood) is denoted on each figure by the large red arrow.

The results suggest few significant differences in the range and concentrations of particles through time. The with-terminal groin result does indicate initial higher concentrations of particles in the intertidal nearshore principally east of the beach fill limit. The apparent stranding of particles in the intertidal beach here is consistent with the drogue tracking result. As the tracer particles begin to mobilize into the inlet, increased particle concentrations along this reach subside and gain consistency with the fill only concentrations within about two days following insertion.

Spring Tide Condition. **Figures 34** through **41** plot the particle distribution at various intervals in time following spring tide insertion. The results for both spring and neap tide insertion times are similar in that the terminal groin appears to have little influence over the transport patterns of the tracer particles. Specifically, under both conditions, particles which enter the inlet on a flood tide and do not enter the very shallow portions of the estuary are subsequently mobilized offshore on the following ebb tide. A portion of these particles are returned into the inlet on the following flood tide(s) eventually becoming well distributed throughout the river, estuary, and marsh areas after only a few days. Alternatively stated, the large scale motion paths of the particles appear to generally follow pathways similar to those computed for the residual tides shown in **Figures 3** and **4**. The presence of the terminal groin appears to have no significant limiting influence on the ability of particles to enter the estuary and ebb/flood transport pathways described above. The size of the modeled terminal groin pales in scale to that of the overall range of distributed particles the spatial extent of which does not materially differ between with and without terminal groin conditions.

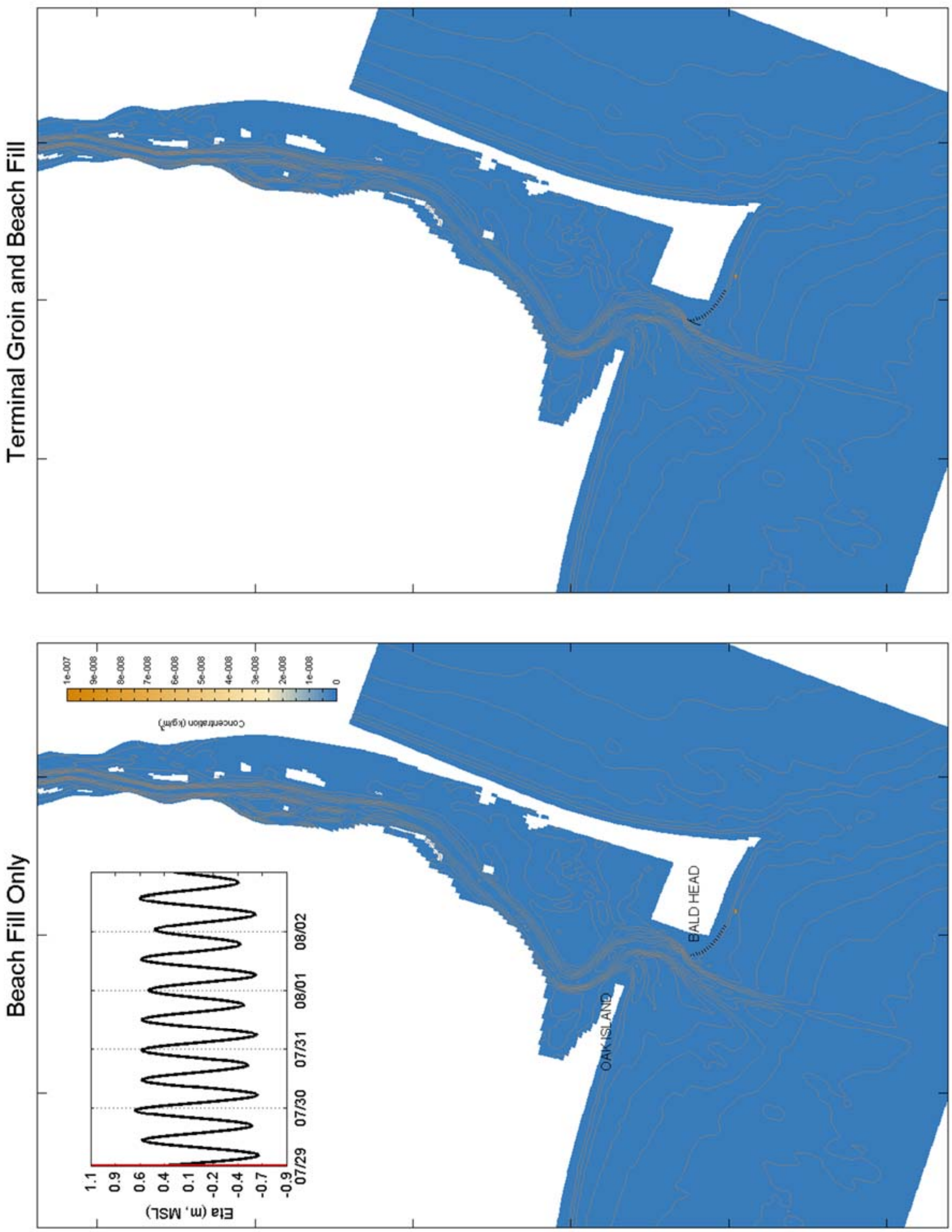


Figure 26: Particle concentration map 0 days following neap tide insertion.

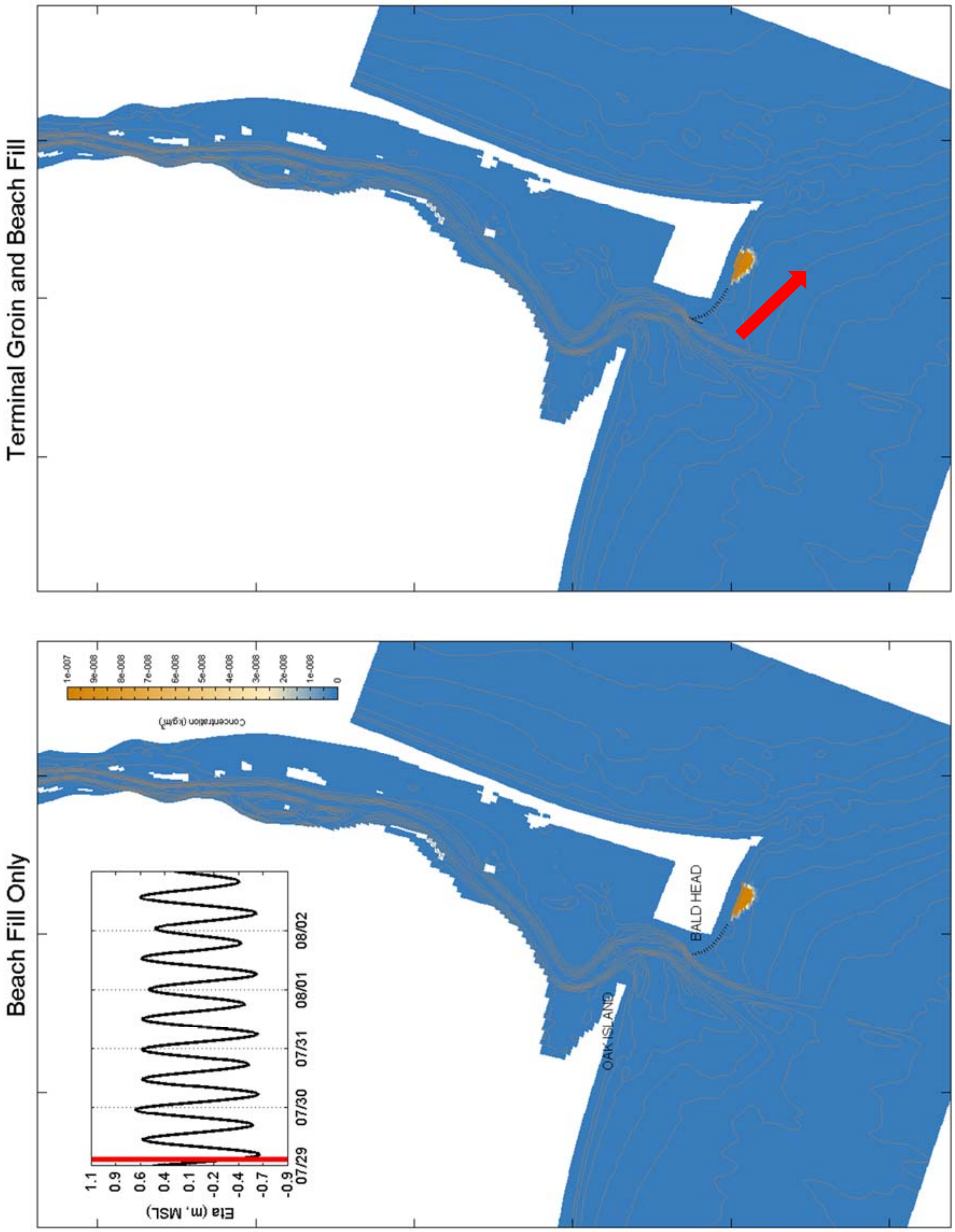


Figure 27: Particle concentration map hours following neap tide insertion.

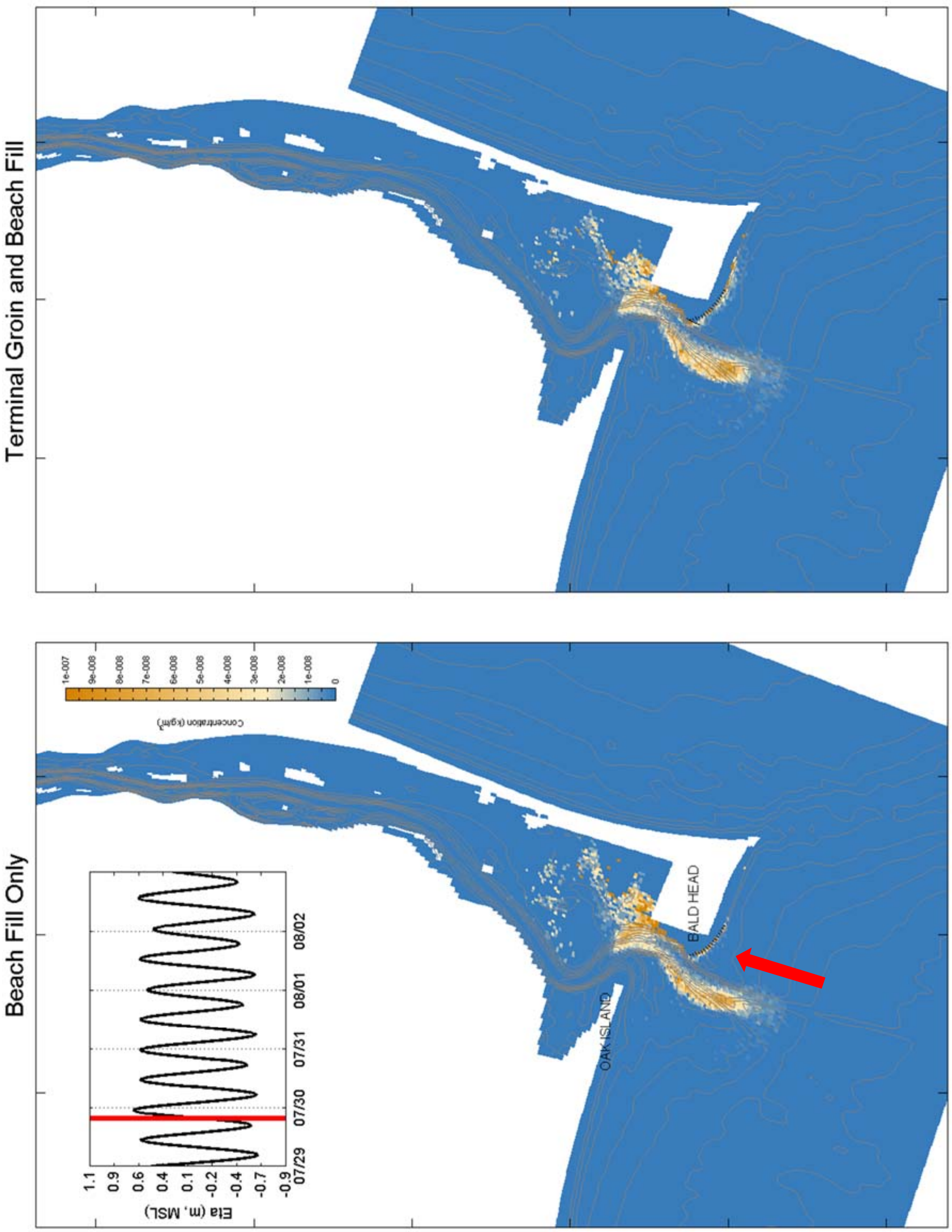


Figure 28: Particle concentration map about 1 day following neap tide insertion.

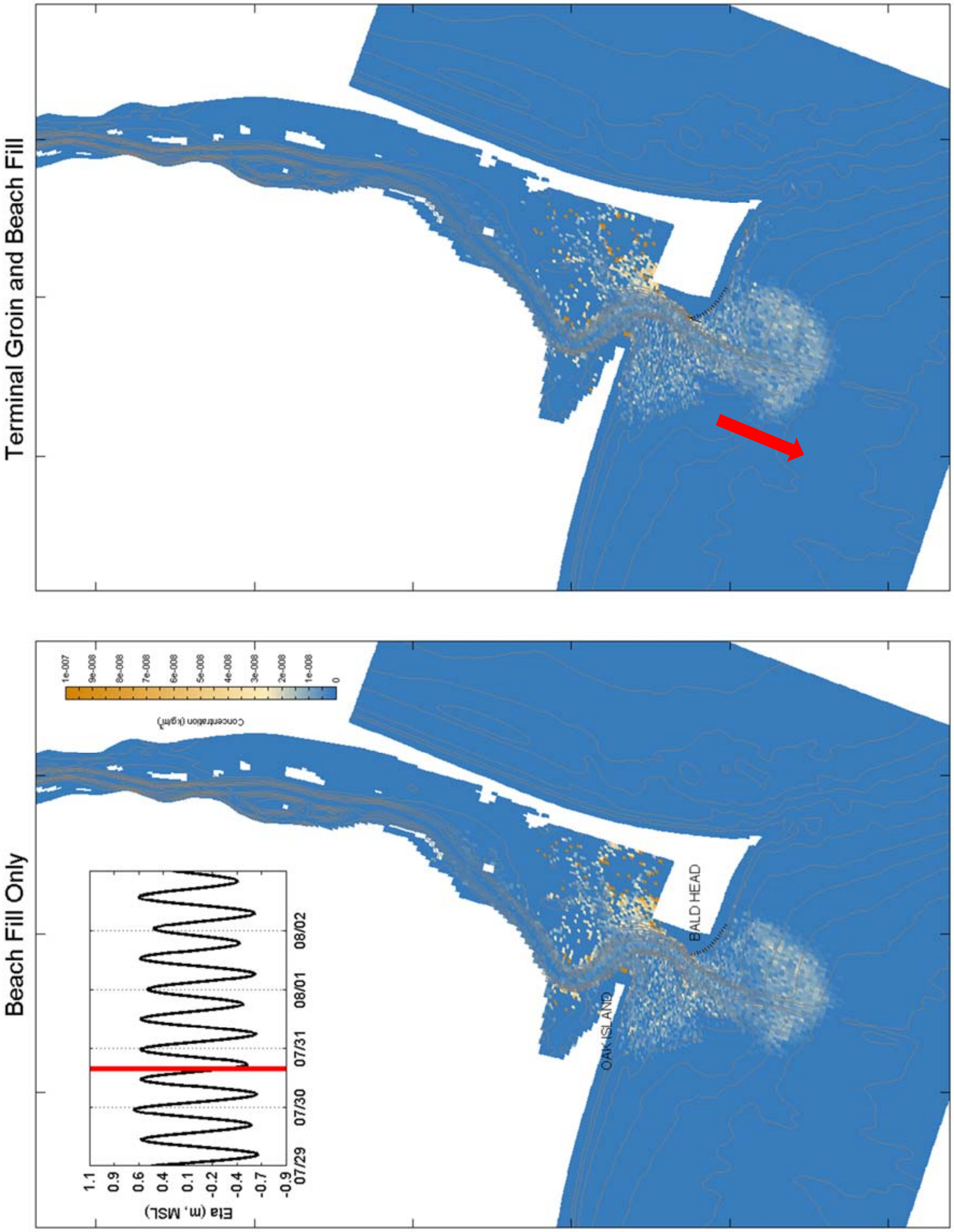


Figure 29: Particle concentration map about 1.7 days following neap tide insertion.

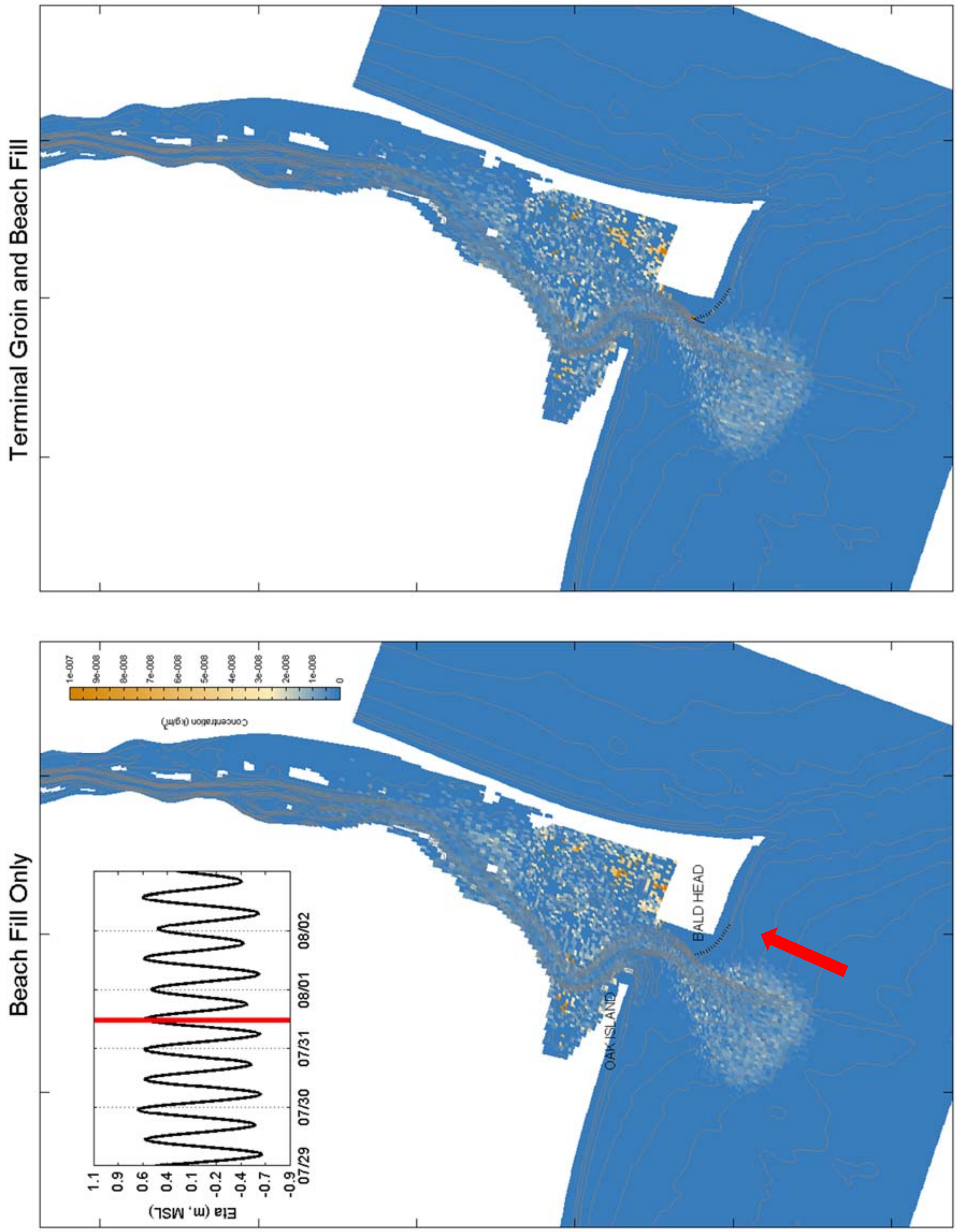


Figure 30: Particle concentration map about 2.5 days following neap tide insertion.

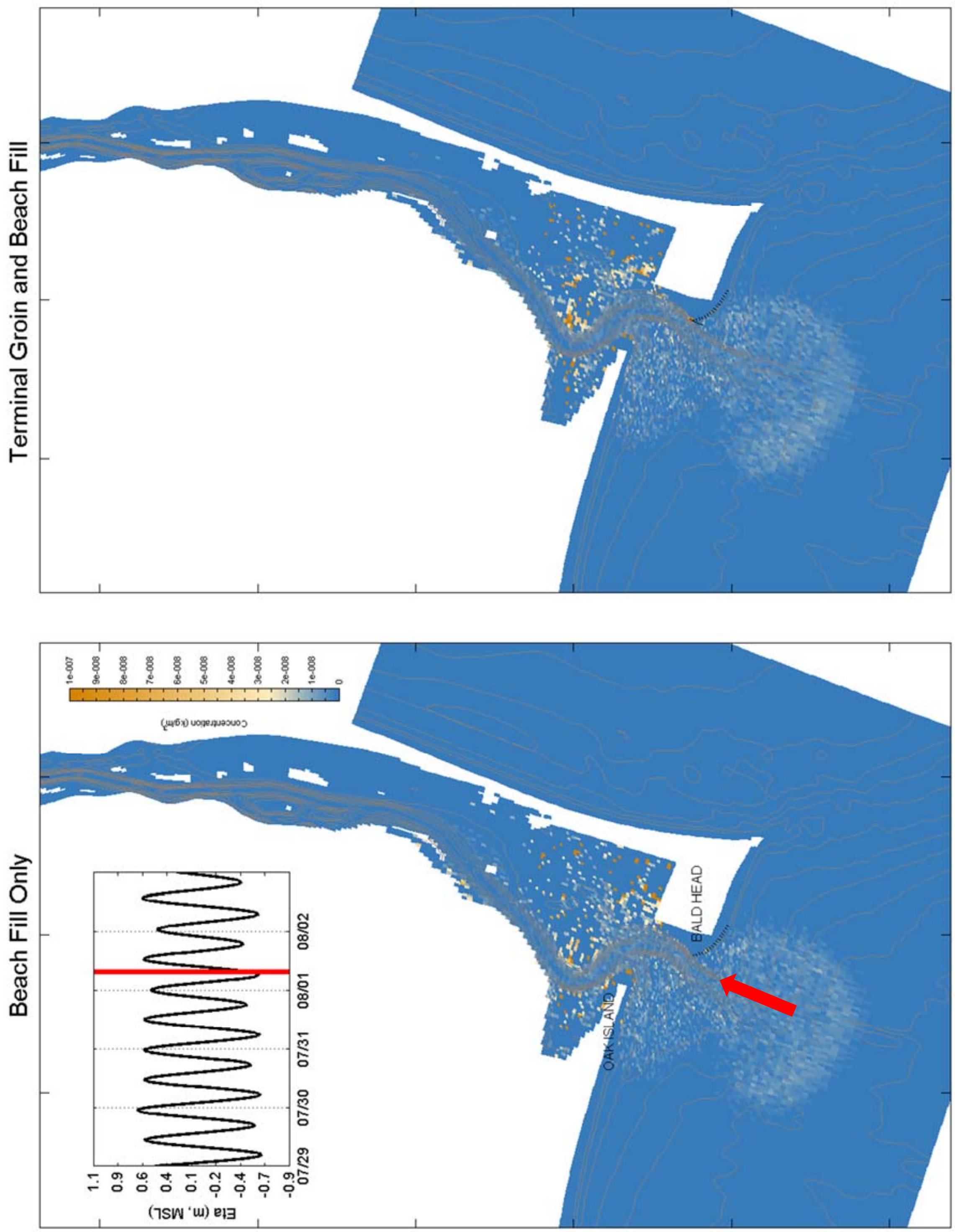


Figure 31: Particle concentration map 3.25 days following neap tide insertion.

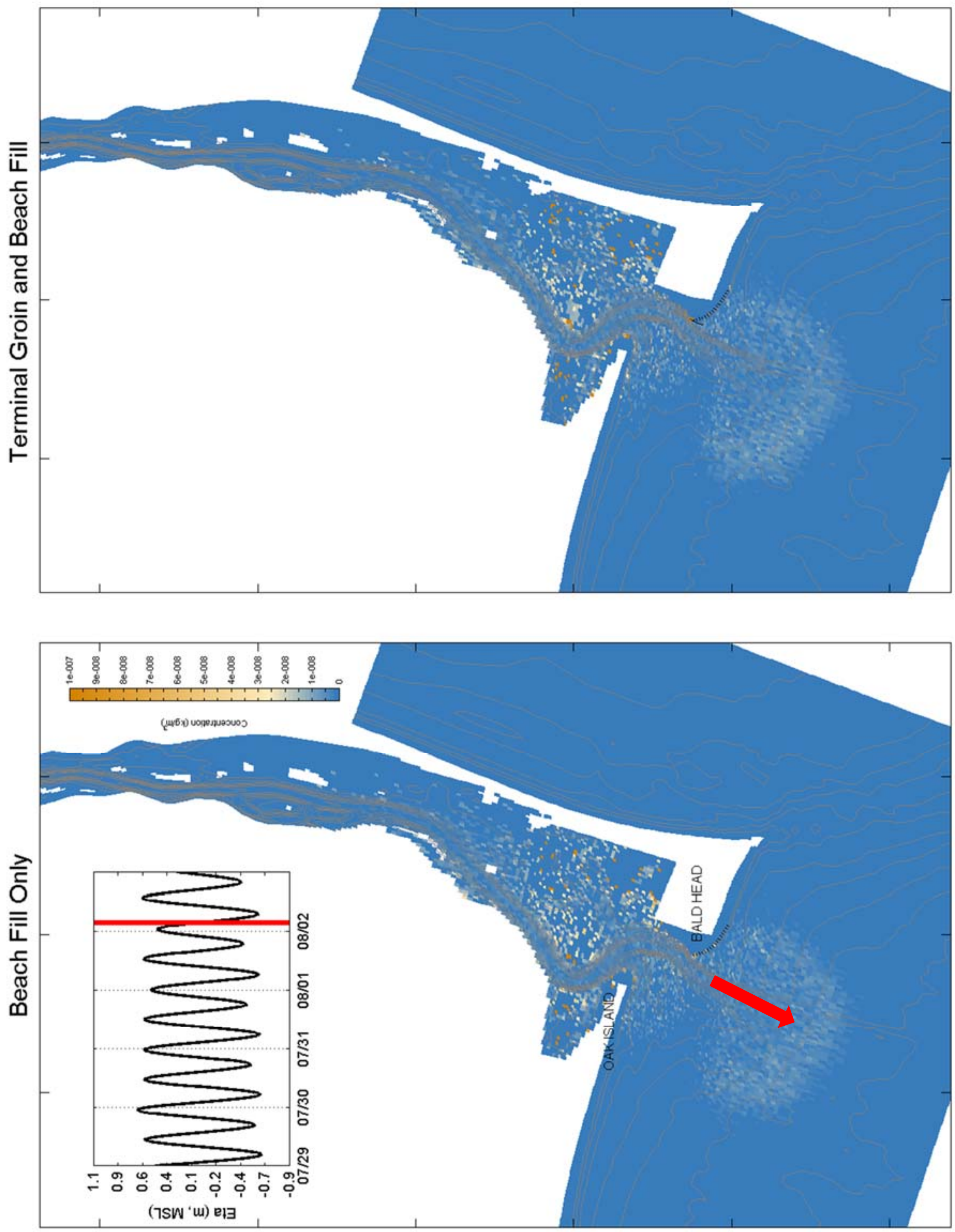


Figure 32: Particle concentration map about 4 days following neap tide insertion.

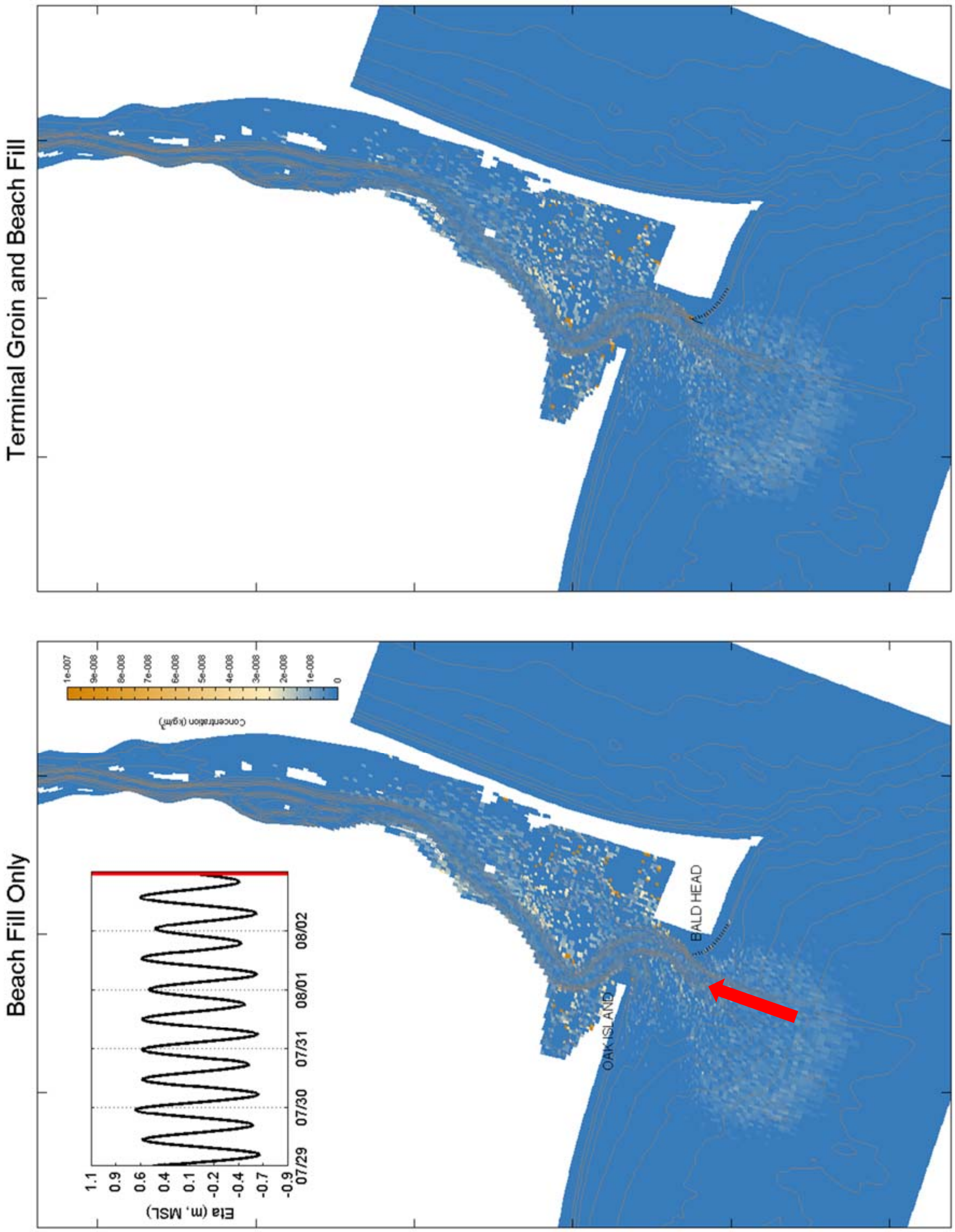


Figure 33: Particle concentration map 5 days following neap tide insertion.

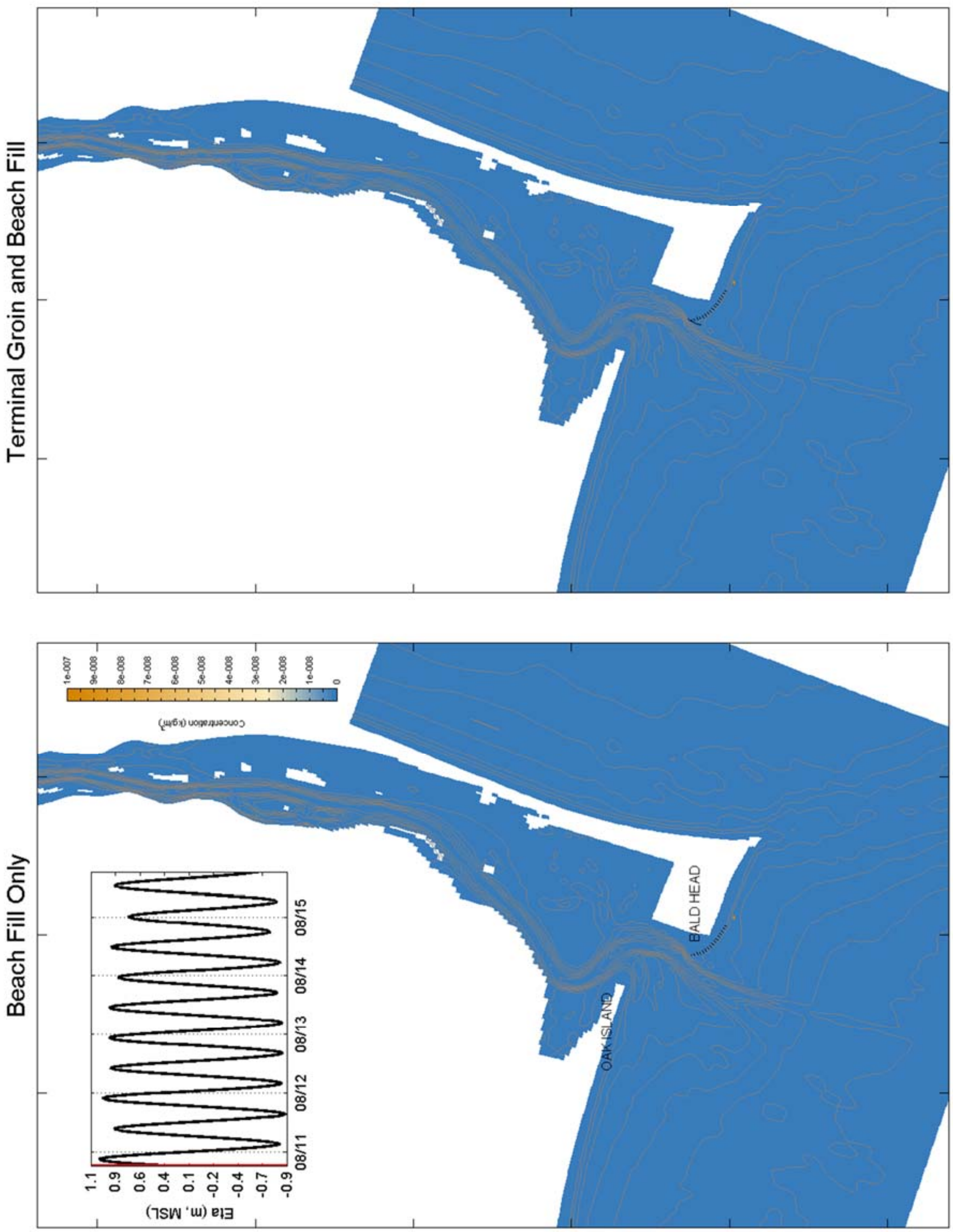


Figure 34: Particle concentration map 0 days following spring tide insertion.

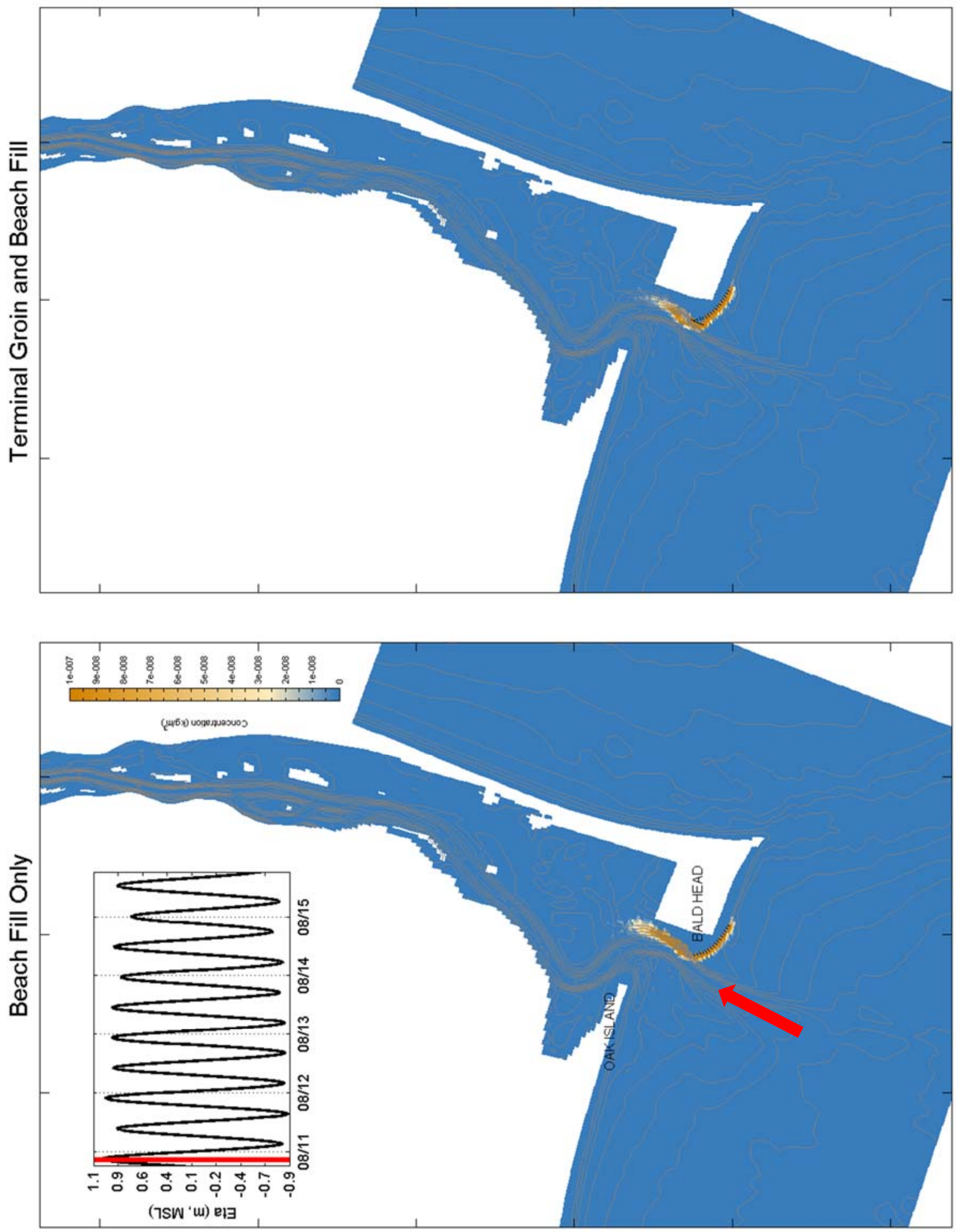


Figure 35: Particle concentration map hours following spring tide insertion.

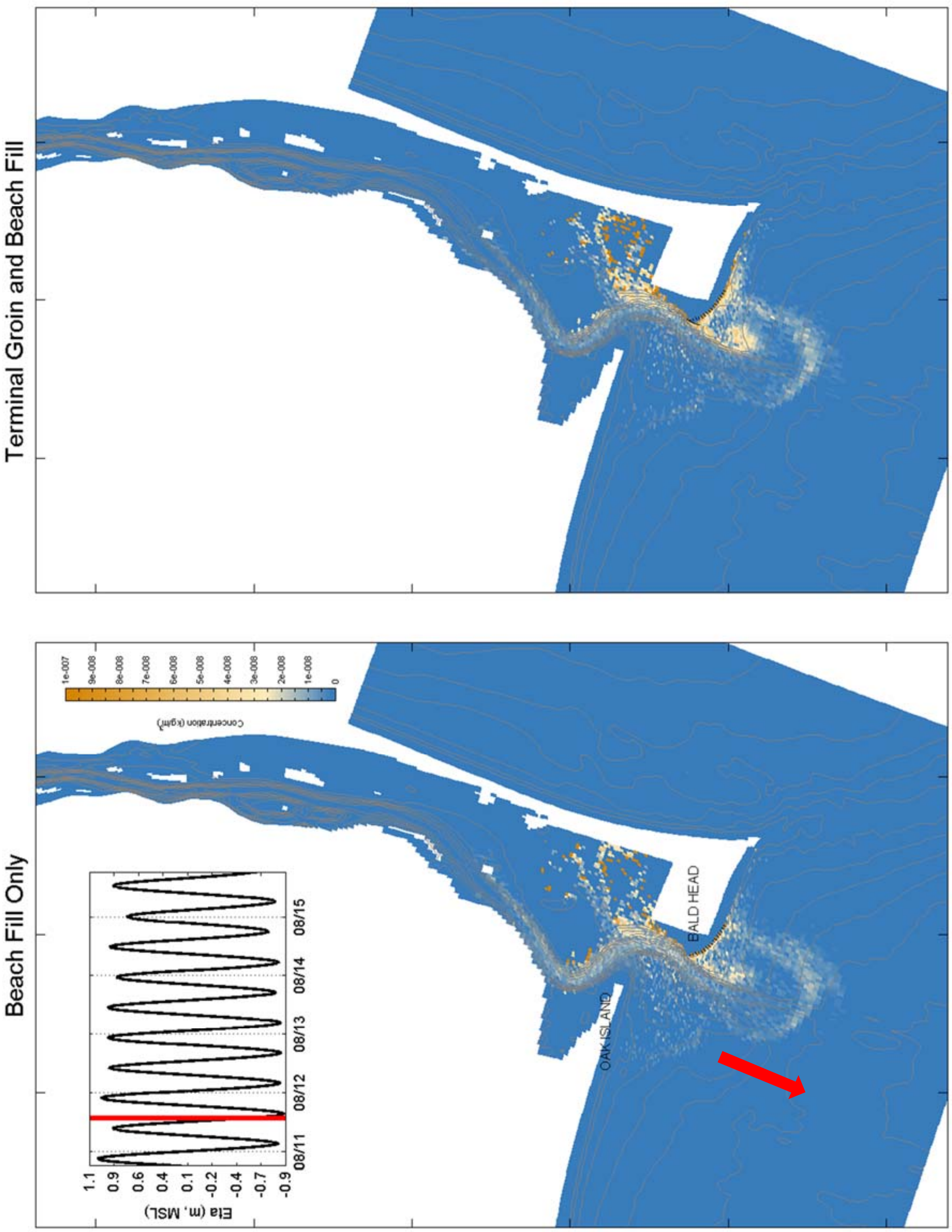


Figure 36: Particle concentration map about 1 day following spring tide insertion.

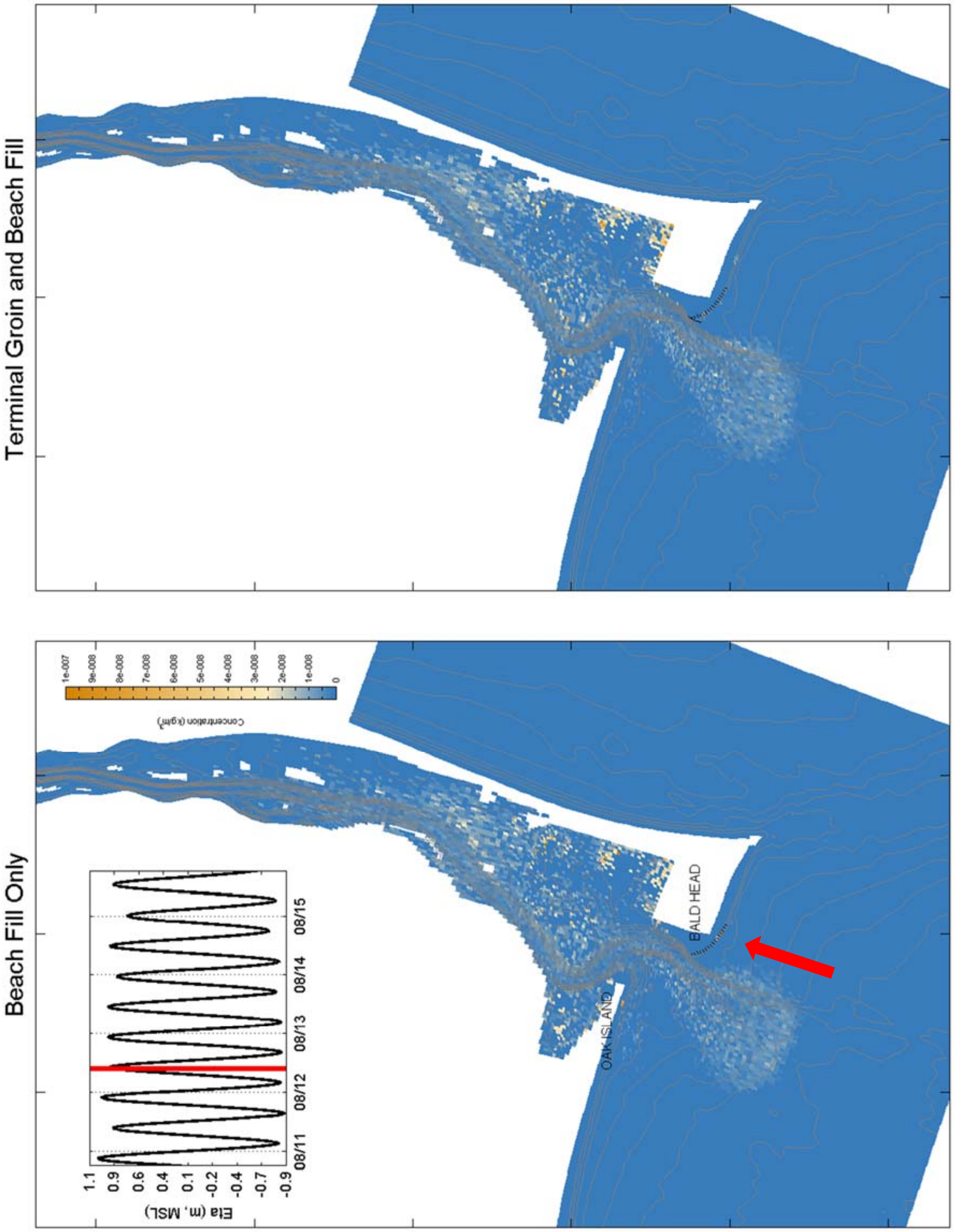


Figure 37: Particle concentration map about 1.7 days following spring tide insertion.

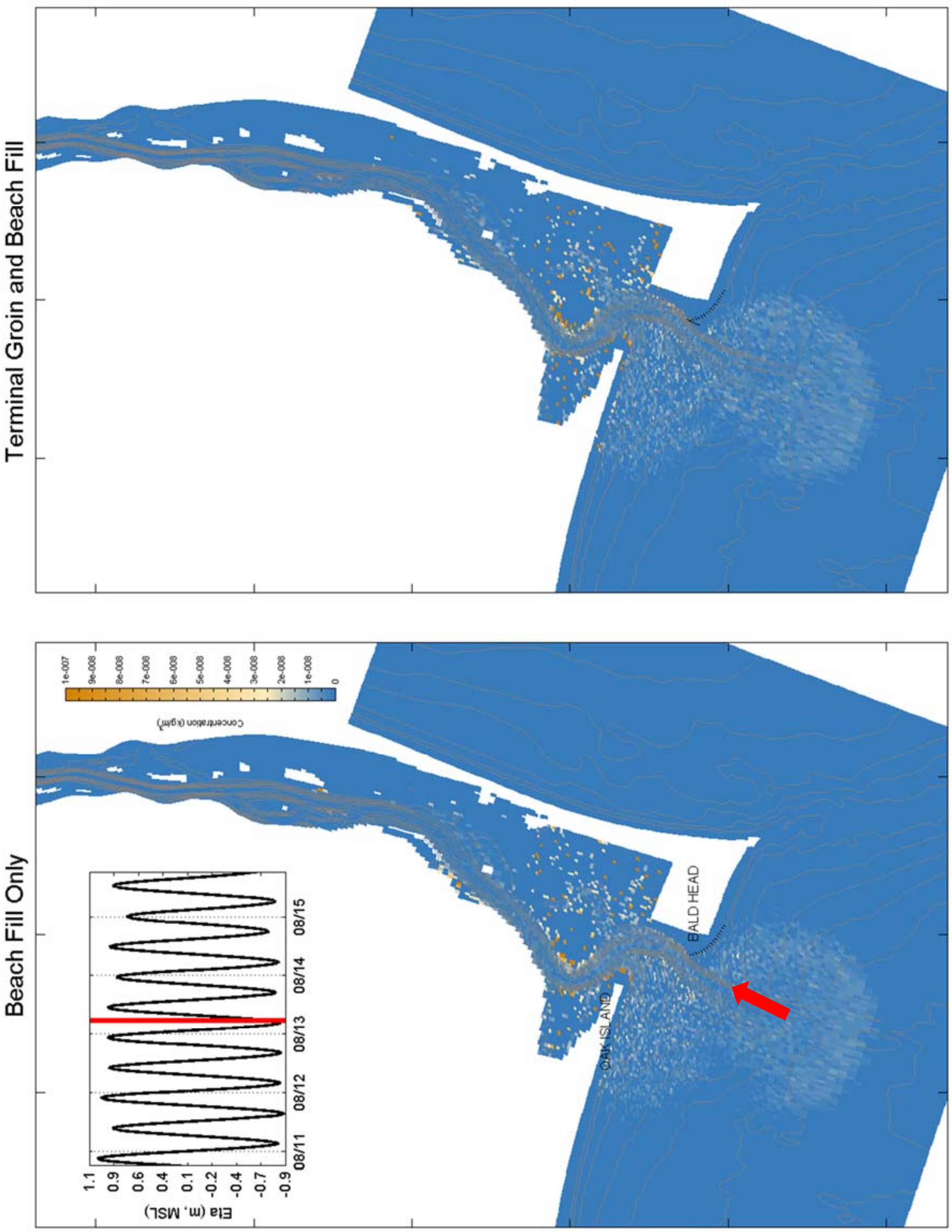


Figure 38: Particle concentration map about 2.5 days following spring tide insertion.

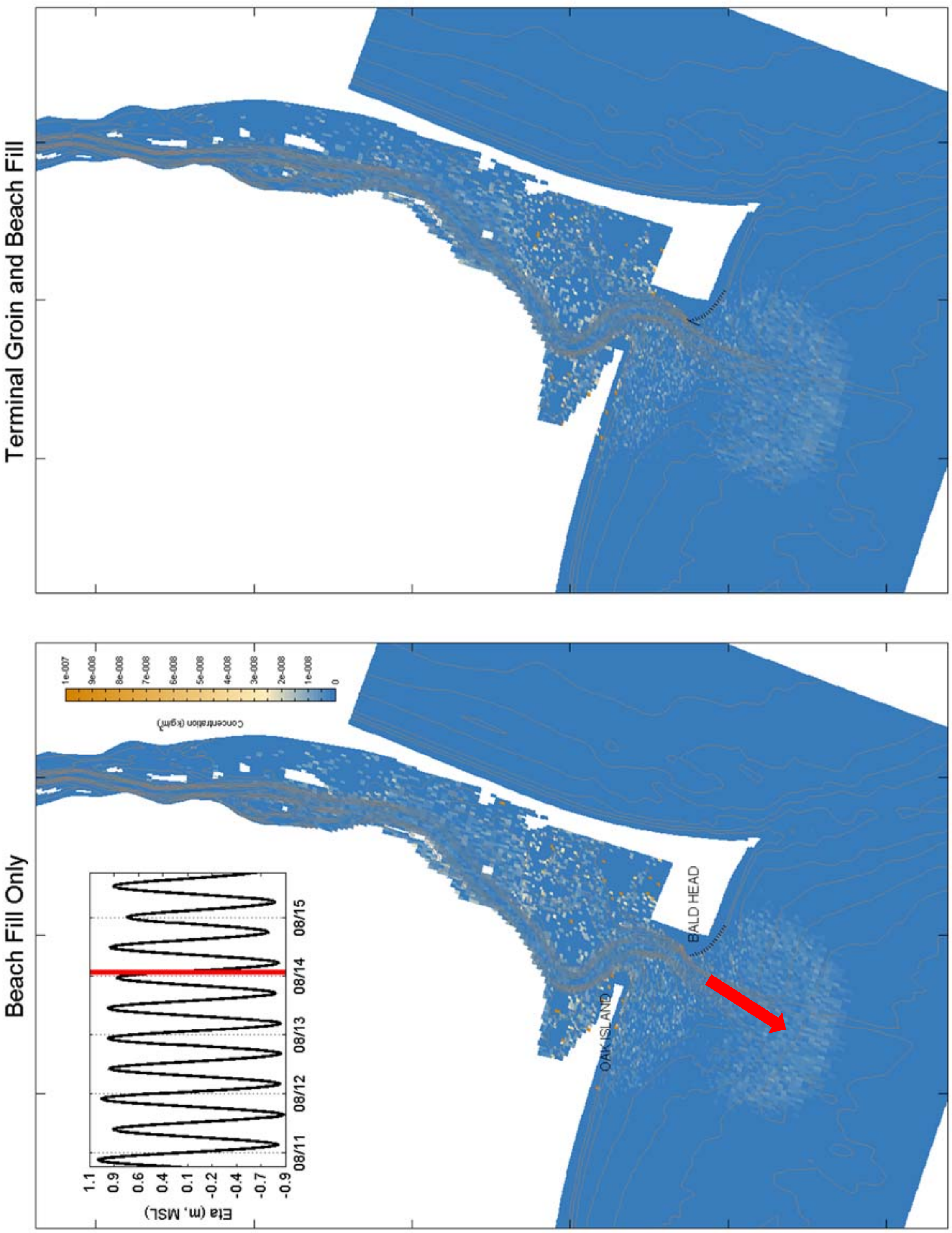


Figure 39: Particle concentration map about 3.25 days following spring tide insertion.

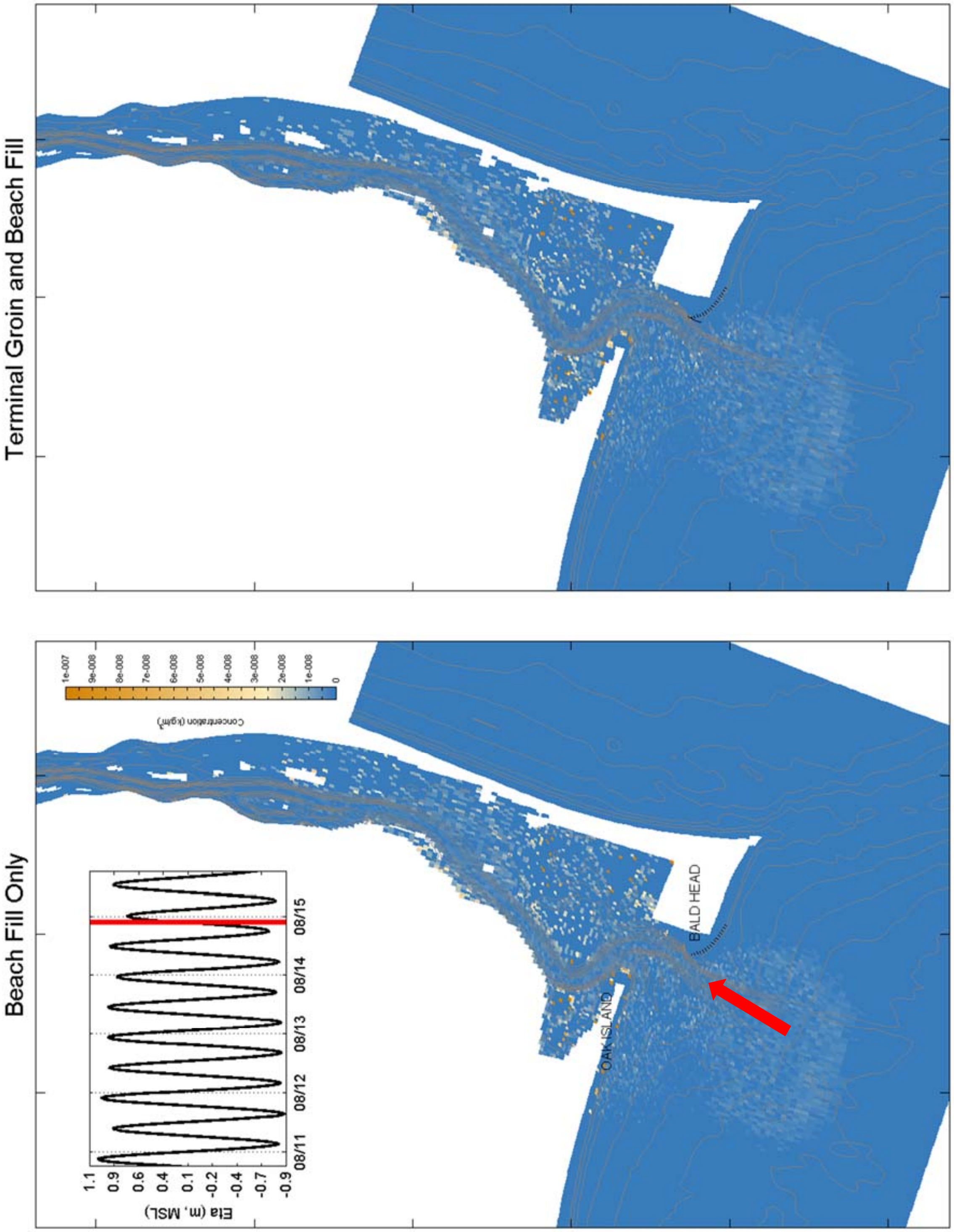


Figure 40: Particle concentration map about 4 days following spring tide insertion.

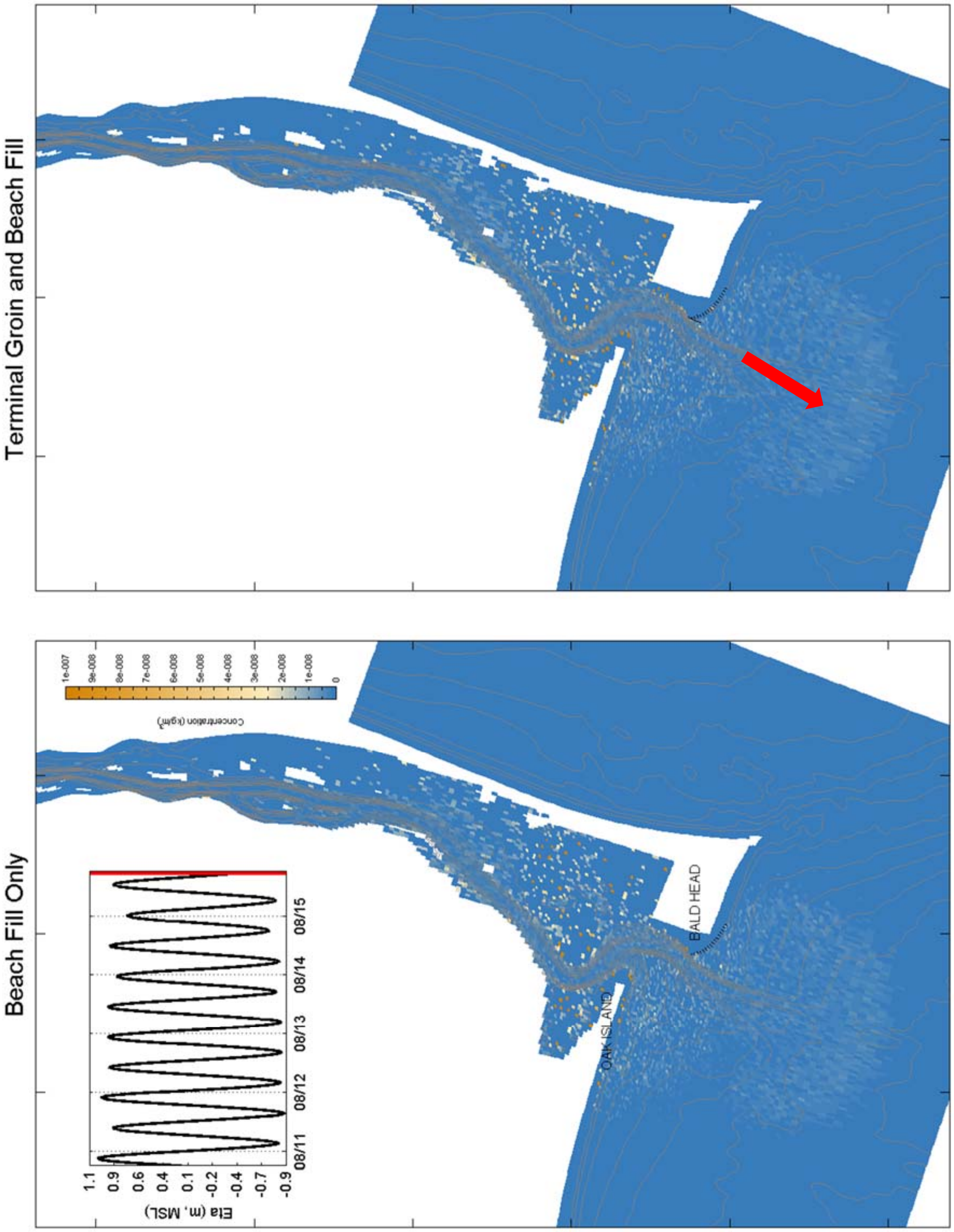


Figure 41: Particle concentration map 5 days following spring tide insertion.

APPENDIX N

SEA TURTLE NESTING LOCATIONS (2007-2011)

Coordinate locations of turtle nests provided by others, and are not intended to be survey grade.
Aerial photograph is dated 2012.
Data for turtle nest locations continues along East Beach north of Middle Island (not shown).

Legend
2007 Loggerhead Nest Locations

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project:	**Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**
Title:	***Turtle Nests 2007*** ***Bald Head Island Conservancy Data***
Date:	10/13/2013
Revision Date:	NA
Scale:	1"=1500'
Job Number:	40-11-238
Drawn By:	
Sheet Number:	**Appendix N Sheet 1**

Coordinate locations of turtle nests provided by others, and are not intended to be survey grade.
Aerial photograph is dated 2012.
Data for turtle nest locations continues along East Beach north of Middle Island (not shown).

Legend
2008 Loggerhead Nest Locations

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 10/13/2013	Revision Date: NA	
	Scale: 1"=1500'	Job Number: 40-11-238	
Title: ***Turtle Nests 2008*** ***Bald Head Island Conservancy Data***	Drawn By:	Sheet Number: **Appendix N Sheet 2**	

Coordinate locations of turtle nests provided by others, and are not intended to be survey grade.
Aerial photograph is dated 2012.
Data for turtle nest locations continues along East Beach north of Middle Island (not shown).

Legend
2009 Loggerhead Nest Locations
2009 Green Sea Nest Locations

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project: **Village of Bald Head Island Shoreline Protection Project**
Draft Environmental Impact Statement

Title: ***Turtle Nests 2009***
Bald Head Island Conservancy Data

Date: 10/13/2013
Revision Date: NA
Scale: 1"=1500'
Job Number: 40-11-238
Drawn By:
Sheet Number: **Appendix N Sheet 3**

Coordinate locations of turtle nests provided by others, and are not intended to be survey grade.
Aerial photograph is dated 2012.
Data for turtle nest locations continues along East Beach north of Middle Island (not shown).

Legend
2010 Loggerhead Nest Locations
2010 Green Sea Nest Locations

LMG
LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
Telephone: 910-452-0001

Project: **Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**	Date: 10/13/2013	Revision Date: NA
	Scale: 1"=1500'	Job Number: 40-11-238
Title: ***Turtle Nests 2010*** *Bald Head Island Conservancy Data*	Drawn By:	Sheet Number: **Appendix N Sheet 4**

Coordinate locations of turtle nests provided by others, and are not intended to be survey grade.
Aerial photograph is dated 2012.
Data for turtle nest locations continues along East Beach north of Middle Island (not shown).

Legend

2011 Loggerhead Nest Locations
2011 Green Sea Nest Locations

LMG LAND MANAGEMENT GROUP INC.
Environmental Consultants
Post Office Box 2522
Wilmington, North Carolina 28402
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Project:	**Village of Bald Head Island Shoreline Protection Project** **Draft Environmental Impact Statement**
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APPENDIX O

UNDERSTANDING THE COSTS AND BENEFITS OF SHORELINE CHANGE

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Appendix O: Understanding the Costs and Benefits of Shoreline Change

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1.0 Introduction

Actions associated with mitigating the effects of shoreline change are expected to create an array of costs and benefits. These include market costs, such as any physical or engineering costs associated with active mitigation, as well as non-market costs and benefits, such as those associated with changes in the quality of recreational experiences and effects on the natural environment. Shoreline nourishment, armoring via hardened structures, or retreat each entail costs and benefits that accrue to different groups of stakeholders and over different time periods. As noted in Landry (2011), nourishing shorelines by adding sand may protect coastal habitats and real estate as well as the possibilities for recreation, but without maintenance, the duration of such benefits can be expected to be temporary. Armoring the shoreline may likewise protect coastal property, but may have adverse impacts on habitats and proximate shorelines. Shoreline retreat will involve relocation or demolition of existing buildings and infrastructure and can be expected to impose substantial costs and burdens on coastal property owners. Local governments may also be opposed to shoreline retreat for reasons related to the potential infrastructure losses, diminished property tax revenues, and impacts on coastal tourism, or real estate sales (Landry, 2011).

As a result of these disparate costs and benefits, alternative efforts to mitigate shoreline erosion can be expected to be valued differently by different groups of people. Direct and indirect economic impacts from alternative shoreline management strategies will vary across a given population, as will preferences for maintaining, preserving or allowing natural change (Judge, Osborne and Smith, 1995). As noted in Judge, Osborne and Smith (1995), some individuals will have preference for non-interventionist approaches that allow natural erosion to take place. These individuals may derive real economic value from the existence of unfettered coastal ecosystems. While such "retreat" options will likely have an adverse impact on the value of beaches and beach front property at eroding sites, they may also induce positive or negative value changes at proximate sites via changes in crowding or changes in aesthetic appeal. For example, as noted in Parsons and Powell (2001), the amenity value of beachfront properties lost to erosion may not be lost in the aggregate, but rather transferred to properties further inland. Further, in the absence of land use controls active mitigation efforts such as beach armoring or renourishment may serve to encourage additional use and/or development, which may in turn compromise the integrity and value of the beach that such efforts were designed to protect or create a situation where continued mitigation is necessary to protect value. With regard to this latter point, Gopalakrishnan et al. (2011) find that beach replenishment activities are likely to occur more frequently in communities where baseline property values are higher.

Finally, certain groups of stakeholders may have different and contrasting values related to natural or anthropogenic changes to the shoreline. For example, as noted in Landry, Keeler and Kriesel (2003), property owners may desire shoreline proximity for recreational and aesthetic reasons and also value shoreline distance for protection from erosion. Huang et al. (2007) also note that anthropogenic modifications to beaches involve multiple positive and negative impacts on individual stakeholders. They find that erosion control measures are less valued when there are adverse impacts on wildlife, water quality and erosion at neighboring beaches.

In light of diverse impacts and preferences, economic analysis of the potential gains and losses from proposed shoreline management actions can be a useful input for policy makers who are confronted with the need to balance conflicting objectives while conforming to budgetary limitations. However, as alluded to above, understanding the economic values associated with shoreline management alternatives is a complex and multifaceted undertaking. Determining which strategy makes the most economic sense for a given coastal community is an empirical question, requiring detailed consideration of an array of natural, physical and socioeconomic characteristics (Parsons and Powell, 2001) and forecasting potential impacts into the future. Coupling these complexities with the inherently dynamic nature of marine coastlines suggests that the effects of shoreline management alternatives will vary according to myriad factors such as preferences for recreation, the degree of shoreline development, the characteristics of proximate and substitute sites and the bio-physical character of affected coastal ecosystems. As such, quantitative forecasting of the economic impacts of shoreline management alternatives is fraught with difficulty. Such analysis is beyond the scope of this report.

2.0 Limitations

The purpose of this report is to review the extant literature regarding economic considerations that are pertinent to the proposed management alternatives for the Bald Head Island Shoreline Stabilization Project and to summarize available evidence in the literature so as to frame and characterize the potential scope of economic costs and benefits associated with the proposed alternatives. This report does not provide an itemization or explicit estimation of economic values associated with the management alternatives, nor does this report provide a ranking of alternatives based on relative economic values or any other criteria. This report should not be considered a substitute for a monetary cost-benefit analysis, but rather should be taken as a framework for understanding the potential scope of economic impacts associated with the range of project alternatives evaluated in the Environmental Impact Statement (EIS).

3.0 Economic Value and Valuation

Economists define the value of a particular good or service as what it is *worth* to people, in terms of the contribution of the good or service to well-being (Bockstael et al., 2000). Value is best measured by what people are *willing and able to pay* (WTP) for a good or service. Value should not be confused with the *cost* or expenditure required to obtain a good or service, because cost may differ greatly from what something is worth. For example, a beach renourishment project may involve $5 million in physical and engineering costs, but may generate considerably more (or less) in actual economic value.

It should also be recognized that economic value extends to goods and services that are not explicitly traded in markets such as clean beaches and healthy habitats, and may include benefits not directly associated with use, such as benefits resulting from the knowledge that particular species or ecosystems exist (“existence values”), are available for potential future use (“option values”), or are available for future generations (“bequest values”). The measurement of non-market values is detailed in later sections of this report. Evidence in support of “non-use values” includes the willingness of people to give up time and other resources (including money) for goods and services that they never interact with in any tangible fashion. While relatively unknown outside of the economics profession, the consideration of non-market and non-use values is germane to any analysis of beach management alternatives due to their explicit mention in the Water Resource Council Principles and Guidelines (P&G) for federal projects (USACE, 2000 as noted in Landry, 2011). A deep body of literature examines these values in a wide range of contexts and for numerous species and ecosystems. We highlight some of those that pertain to shoreline stabilization projects later in this appendix.

More generally, it is clear that coastal ecosystems provide a variety of goods and services that create economic value via contributions to human well-being. These include services that affect the value of goods that are traded in markets such as the protection of coastal real estate and tourism as well as services that impact non-market goods and services such as aesthetics, habitat provision and opportunities for recreation. Quantifying the associated benefits to people from these goods and services is the domain of economic valuation. Valuation simply means empirical estimation of what something is worth, typically in monetary terms.

3.1 Valuation Methods

Because humans interact with the environment in many ways, approaches to valuation take a variety of forms. The choice of method is most often a function of what is being valued and the intended use or policy purpose of the values. A common point of demarcation for valuation methods pertains to whether the economic values in question are market-based or “non-market” values. Market values are often readily observed using applicable prices and quantities. Measuring and monetizing the costs and benefits associated with changes that are not revealed in market transactions requires the application of empirical techniques that fall under the category of non-market valuation. Examples of non-market values include changes in human wellbeing associated with aesthetics, opportunities for recreation and changes to the natural environment. Non-market valuation techniques are well-established in the academic and practitioner literature.

Examples of market-based valuation methods include the market price method, the replacement cost method and the damage avoidance method. Non-market valuation methods include the travel cost method, hedonic pricing and the contingent valuation method. A variety of sources are available for detailed reviews of these methods (e.g. Smith, 1996; Bockstael, et al., 2000; Schuhmann, 2012). For the purposes of this report, we only review those methods that are pertinent to the valuation of changes to coastal systems. Much of the review below is based upon Schuhmann (2012).

3.1.1 The Replacement Cost Approach

Some goods and services provided by the natural environment can be replaced by manmade goods and services. This basic idea is the foundation of the *replacement cost approach* (RC) to valuation, which uses the *costs* associated with providing replacement services as the value of the associated natural services. As such, this approach fits into the category of market-based valuation methods. As an example, artificial breakwaters may provide some of the shoreline protection services afforded by barrier islands or reefs. The costs of constructing breakwaters may therefore be used as an estimate of the economic value that stands to be lost if the natural service was to be degraded. The replacement cost approach is appealing in its ease of calculation and interpretation – the method typically relies on readily available market data and represents the opportunity costs associated with the degradation of natural assets in terms of costs that would have to be incurred in the absence of protection.

The replacement cost approach should be used with caution, however, as it does not deliver a true measure of the value of natural goods and services in the sense of net gains to society. In short, the replacement cost method provides a measurement of *costs*, which may not reflect the benefits gained from natural resources. For example, the cost of widening a beach via sand management may be entirely unrelated to the benefits derived from naturally wide beaches. Moreover, this method should only be applied when certain conditions are met (Bockstael et al., 2000; EPA, 2009; WRI, 2009). First, the manmade alternatives must provide an effective replacement for natural services. While it is unlikely that manmade alternatives can provide the full range of benefits provided by natural assets, there must be at least some service flows that can be attained via substitution of manmade alternatives. Further, the costs of that substitute must be known or estimable and must represent the least-cost means of providing the service in question. Finally, society must be willing and able to incur the costs associated with the replacement. These latter two points may require extensive research to confirm, as the scope of economic costs associated with habitat modification likely extends beyond monetary or market-based expenses. Only when these non-market costs are understood, measured and conveyed to the public can society's willingness to accept them be established.

3.1.2 The Cost (Damage) Avoidance Approach

Related to the replacement cost approach, the *cost (damage) avoidance approach* (CA) is based on the idea that manmade services may be able to offset or prevent harm caused by natural or anthropogenic change. The cost avoidance approach relies on market-based estimates of the costs associated with potential damage to manmade assets as an estimate of the value of the natural services that prevent those damages from occurring. For example, the cost of replacing coastal property may be used as an estimate of the benefits derived from beach nourishment activities that mitigate damage from storms. As noted in Landry (2011), this is the approach employed by the US Army Corps of Engineers when defining benefits in P&G. As is the case with the replacement cost approach, this method ascribes estimates of *costs* to notions of *value*, which may be an inherently flawed means of understanding the *benefits* derived from changes in natural resources. Using the value of coastal real estate as an estimate for the value of beach width may lead to the conclusion that highly developed beaches are worth more than undeveloped beaches. While this may seem logical from a private landowner's perspective, the opposite may be true from the perspective of society. That is, undeveloped beaches may confer larger economic gains to society than developed ones. Landry (2011) provides additional discussion of this important issue.

3.1.3 Revealed Preference Methods

In terms of understanding the economic value of beach width and shoreline amenities, the most commonly employed non-market valuation methods are the revealed preference approaches of *hedonic pricing* method and the *travel cost method*. These approaches are based on establishing empirical links between changes in natural resources and market behaviors. For example, beach width may affect sales prices of coastal real estate or influence the number of tourists that visit a particular destination. By collecting data on real estate sales or travel to the coast, the associated value of beach width can be estimated. Specifically, the hedonic pricing method uses data on house characteristics (size, age, neighborhood characteristics, etc.), associated environmental amenities (e.g. proximity to the coast or beach width near the house) and selling prices. To estimate the contribution of those environmental amenities to the market value of the house, regression analysis is used where price serves as the dependent variable and independent variables are house characteristics, including environmental amenities. The estimated regression coefficient on the environmental characteristic represents the marginal change in average selling price for a change in that characteristic, and can be interpreted as the implicit price of the characteristic. Because this method relies on actual transactions, value results are difficult to critique, provided that proper methodology was employed and that the environmental characteristics of interest were accurately quantified and have not undergone meaningful change since the time of the real estate transactions. The literature contains several applications of the hedonic pricing method to value coastal attributes, many of which are reviewed herein.

The travel cost method is another revealed preference approach that is commonly employed to value natural resources associated with recreation. Site visitation data, including travel costs and the number of trips taken to a particular destination are collected and used to estimate a trip demand curve, where explicit and implicit travel expenses serve as a proxy for price. The net benefits of a particular site or the value of the resources within each site can then be estimated by integrating under the estimated demand curve at a particular price point (e.g. mean or median price). Numerous examples of recreation demand models applied to value beach visitation appear in the published literature. Pertinent applications are reviewed later in this report.

3.1.4 Stated Preference Methods

The above methods are useful for understanding the economic value associated with property and recreation aspects of coastal quality and amenities, but they are not amenable to the valuation of benefits that are not associated with direct use. When people derive values from simply knowing that natural resources are preserved or maintained in a particular state, s*tated preference methods* such as the Contingent Valuation Method (CVM) and Choice Modeling (CM) must be employed. These methods, which rely on surveys to elicit values, are well-accepted approaches for valuing non-market goods and services. CVM has been adopted by the U.S. Department of Interior to measure non-market values associated with damages under CERCLA 1980 (US DOI 1986), while NOAA has endorsed the use of this method for damage assessment under the Oil Pollution Act of 1990 (Arrow et al. 1993). The CM approach appears to be gaining favor in the economics literature as it avoids many of the difficulties associated with CVM and allows multidimensional attribute changes to be valued simultaneously (Huybers, 2004). As is the case with all valuation approaches, estimates of value are subject to an array of biases and caveats, hence care must be taken with regard to proper methodology and interpretation.

3.1.4 Economic Impact Analysis

In addition to estimating changes in economic value to users, property owners and other direct stakeholders, analysts may be interested in understanding the effects of changes in natural resource quantity or quality on the broader economy. Such impacts might include additional revenues, incomes and employment realized by local, regional and national economies. *Economic impact analysis* is the process concerned with such estimation, and recognizes that a portion of each dollar spent by a consumer or producer represents revenue earned by someone else in the economy. As the new revenue earner spends that income, each transaction creates additional income that ripples through businesses and households creating “economic multiplier effects”. These impacts are estimable, and are typically categorized into *direct* effects, *indirect* effects and *induced* effects. *Direct effects* are market contributions to the economy, and are typically measured by gross total revenues, total employment or gross incomes. *Indirect effects* are impacts on the incomes and wages of the suppliers of inputs used in the industry in question when those earnings are subsequently spent on other goods and services. *Induced effects* are the economic impacts of spending of generated income by households who are either directly or indirectly employed in the industry. Indirect and induced effects taken together are often referred to as *value added effects* (Fedler, 2010).

Economic impact analysis relies on the use of input-output models which delineate forward and backward linkages in earnings and spending between economic sectors of interest and the rest of the economy. An empirical understanding of these linkages allows for the estimation of *multipliers* which quantify the extent to which a given economic activity (direct effect) generates other economic activity. Value added multipliers convert direct expenditures into total economic impact (Fedler, 2010). For example, if the estimated value added multiplier for tourism spending is 1.5, then each $1 of direct spending by tourists results in an additional $1.50 of indirect and induced effects, for a total economic impact of $2.50.   Because economic impact analysis does not calculate net economic gains to market participants and does not account for non-market values, economic impact analysis and the use of input-output models should be considered a complement rather than a substitute for the calculation of economic value using other methods described above (Hoagland, et al, 2005).

4.0 Beach Nourishment as a Dynamic Optimization Problem

A recent branch of economics research has examined beach management decisions as a dynamic optimization problem where the timing and rate of renourishment that maximizes the discounted present value of net gains (benefits less costs) is derived (Landry, 2011). Required inputs for such modeling efforts include a rate of natural erosion or decay, the economic costs of beach nourishment, a parameter that converts sand volume to beach width, and a function representing aggregate benefits from beach width. The principle outputs are an optimal schedule of renourishment, the optimal quantity of sand that should be applied during each operation, and a measurement of how these values are affected by changes in the inputs (Landry, 2011). An obvious benefit of this approach is the ability to determine, *a priori*, the potential economic value of beach management actions under a range of hypothetical conditions. A downside is the time, effort and expertise required to conduct the modeling. While it is beyond the scope of this report to apply dynamic optimization models for coastlines in North Carolina, some notable results can be gleaned from prior work in the literature.

5.0 Categories of Potential Impacts from Coastal Management Alternatives

The economic costs and benefits associated with shoreline management projects will include changes in market values and non-market values. Affected market values may include with the physical costs of active mitigation efforts (e.g. construction and maintenance costs associated with hardened structures, acquisition of beach nourishment material, destruction and/or relocation of coastal real estate), and the change in economic value to coastal property and public infrastructure. Non-market values include those associated with changes to the size and integrity of beaches and dunes, inlets and their associated functions, including provision of public recreational opportunities, aesthetics and wildlife habitat. Effects on coastal property values will materialize in market values, and likely entail elements of both market and non-market values. These include changes in the storm protection benefits from beaches and dunes as well as values associated with recreation and aesthetics.

When comparing management alternatives, it is important to note that in many cases the benefits of active mitigation efforts can be considered costs of inaction. For example, the benefits of shoreline stabilization via nourishment or hardened structures include maintaining the integrity of the shoreline and the associated real estate. These economic values are likely to be partially or wholly sacrificed in the absence of active mitigation. Hence, an analysis of the costs of inaction (e.g. retreat) would include lost shoreline integrity and declinations in the economic value of associated real estate. Likewise, the benefits of inaction may include the value associated with maintaining natural environmental conditions in a state unaltered by active mitigation.

A deep body of literature exists examining the nature, scope and measurement of these economic values. Below, we provide a brief overview of this literature so as to provide a context for the potential scope of changes in economic value that might be associated with alternative shoreline management projects under consideration in North Carolina.

5.1 Values Associated with Coastal Property and Physical Capital

Natural and anthropogenic changes to shorelines can be expected to affect the value of coastal real estate. The value of at-risk property can be viewed as a potential economic cost associated with inaction (e.g. retreat) or an economic benefit of protection via active management (e.g. nourishment, armoring). Hence, an appraisal of coastal property values and/or derivation of the effect of beach characteristics on property values via the hedonic pricing method can serve as a valuable input in terms of understanding the costs and benefits of management alternatives.

However, caution must be exercised when conducting such appraisals for a number of reasons. First, property values can fluctuate with local and national economic conditions. Available sales, tax assessment or appraisal data may be reflective of market that may no longer be applicable to contemporaneous or future valuations. Further, natural characteristics of coastlines the associated economic benefits are inherently dynamic, which may create empirical difficulties when attempting to quantify the association between those characteristics and property values. For example, even with periodic renourishment, sand volume and beach width can be expected to vary over time. As such, explorations of the relationship between beach characteristics and property values that rely on measurements of those characteristics at a particular point in time may not properly account for anticipated future change or the flow of benefits from average quality metrics (Gopalakrishnan et al., 2011). Indeed, market participants’ understanding of shoreline dynamics and expectations regarding shoreline management interventions will likely be capitalized into market values (Landry and Hindsley, 2011; Landry, 2011). For example, if a strategy of retreat is reasonably anticipated, the value of threatened properties could be driven toward zero (Landry, 2011). Likewise, uncertainty regarding legislative or budgetary conditions may confer a perception of investment risk, which can also be expected to be capitalized into market values. To the extent that shoreline characteristics at the time and location of data collection do not reflect those expectations, value estimates will be compromised.

An additional complication arises from the potential endogeneity between property values and shoreline characteristics. While it is clear that property values will depend on the characteristics of proximate shorelines (additional discussion below), shoreline characteristics may also depend on property values. As noted in Gopalakrishnan et al. (2011), shoreline management decisions may depend on the benefits from changing the natural character of the shoreline. For example, beach nourishment might occur on a larger scale or more frequent interval where beaches protect valuable real estate. This bi-directional causality may confound empirical estimation of the effect of beach width on property values.

To summarize, the value of at-risk property and assets that stand to be lost or protected can and should be considered when appraising the costs and benefits associated with alternative actions for shoreline management. The hedonic pricing method is the most commonly employed approach to understanding the relationship between shoreline characteristics and the market value of such assets, but such analysis should be exercised with careful consideration of the above cautions and caveats.

5.1.1 Categories of Value

Parsons and Powell (2001) categorize the costs of shoreline retreat as land loss, capital (structure) loss, proximity loss, and transition loss. The economic value of land loss is the difference between the value of affected land in the absence of beach erosion and the value of the same land with beach erosion. Because there will always be a given area of land that is beach front, value lost to erosion is associated with diminished land availability inshore rather than the loss of beachfront land. Capital loss is the difference between the asset value of housing, commercial buildings, and public infrastructure in the absence of beach erosion and the value of those same assets with beach erosion, including any loss of use and additional maintenance costs associated with retreat.

Proximity loss is the decrease in human welfare associated with adjusting the pattern of coastal development in response to an unstable shoreline. For example, Parsons and Powell (2001) note that in the face of an unstable shoreline, permanent structures may be rebuilt further from the shore or temporary structures may be built close to the shore. Either case confers less economic welfare associated with proximity than permanent structures built close to the shore, which is the presumed pattern of coastal development when shorelines are stable. Finally, transition loss is the economic costs associated with removal of housing, commercial buildings, and public infrastructure and includes costs of labor, capital and materials. It is important to note that the costs associated with replacing coastal real estate may not be an appropriate proxy for the benefits of avoiding replacement, as the latter entails the value associated with occupying a property, which may or may not be related to construction costs (Landry, 2011).

5.1.2 Examples from the literature

A deep body of literature examines the relationship between the value of coastal real estate and environmental amenities such as views, distance to shorelines, beach width and water quality. Each of these amenities is found to enhance property values as reflected in market prices. The contribution of amenities such as views and beach width is found to diminish with distance from the ocean.

With regard to ocean views, Benson et al. (1997) and Benson et al. (1998) use the Hedonic Pricing approach to estimate the value of scenic views to single family homes in Washington. Both studies find that homes with ocean views are associated with statistically significant price premiums. The 1997 study suggests that ocean frontage adds up to 147 percent to the market price of a home. Views of the ocean add between 10 and 32 percent to market prices, with lower values corresponding to partial views. The richer dataset used in the 1998 study allows for detailed characterization of view quality and distance from the water, and suggests that prices of homes with high quality (unobstructed) views of the ocean are 59 percent higher than prices of otherwise comparable homes on average. Lower quality ocean views convey lower price premiums, ranging between 8 and 31 percent. Not unexpectedly, while controlling for the quality of view, the value of ocean views is found to be inversely related to distance from the water. Prices of homes that are a very short distance from the water with unobstructed views may be more than 68 percent higher than otherwise similar homes.

Pompe and Rinehart (1999) also find that property buyers value ocean views. These authors apply the hedonic pricing approach to home sales in South Carolina and find that views of the ocean add approximately 45 percent to the value of developed lots and 83 percent to the value of vacant (undeveloped) lots.

Numerous studies explore the economic value of beach width to property owners. Pompe and Rinehart (1995) and Pompe and Rinehart (1999) find that property buyers value wider beaches. These two studies - applications of the Hedonic Pricing approach to data from coastal property sales in South Carolina – show that the marginal value of beach width varies with distance from the beach and differs for developed and undeveloped lots. Specifically, Pompe and Rinehart (1995) find that an additional foot of beach width is estimated to increase the value of developed and undeveloped oceanfront lots by $554 and $754 respectively. At a distance of one-half mile from the beach, the price premium for an additional foot of width is found to be considerably lower, roughly $254 and $165 for developed and undeveloped lots respectively. In Pompe and Rinehart (1999), an additional foot of beach width is found to add $194.09 and $310.84 to the market value of developed and undeveloped oceanfront lots, respectively. The authors caution that these latter estimates are based on a relatively small number of oceanfront parcels. Smaller price premiums are found for properties that are not oceanfront with ocean views, and even smaller (but still statistically significant) premiums are found for properties near the beach, but without ocean views.

With regard to loss of beach width to erosion, Parsons and Powell (2001) use a hedonic price regression to estimate the costs of shoreline retreat in Delaware. Specifically, using a range of estimates for average erosion rates at seven different beach communities along the Delaware coast, they approximate the expected location of the shoreline in the absence of active management actions and predict which specific houses would be lost as the shoreline migrates. For each structure that is predicted to be lost, value is predicted using a hedonic price regression based on market data. It is important to note the reason why the hedonic approach is employed rather than simply relying on market values of at-risk real estate: The hedonic approach allows the estimation of the coastal amenity value associated with each structure. This coastal amenity value is subtracted from this anticipated loss under the assumption that such value is simply transferred to other structures that are now closer to the shoreline. The costs associated with removal of the structure (i.e. the transition loss) are assumed to be $25,000 per structure and are added to create an estimate of the total loss associated with losing that property to retreat. Commercial structure losses are approximated using Marshall and Swift's property appraisal method. It is important to note that the authors assume that the majority of the value associated with infrastructure is capitalized into the value of residential structures, and as such the associated losses are captured in the hedonic estimation. To the extent that such infrastructure conveys economic benefits to the public at large (e.g. tourists, or nearby residents), this assumption results in an underestimate of the true costs of retreat. Further, while the authors mention the costs of infrastructure removal and/or relocation, it is not clear that these costs are explicitly accounted for. The authors also do not attempt to estimate proximity losses, which are assumed to be small. Finally, the authors do not account for unstable beach conditions and the effect of such future risk on values of homes that are now closer to the shoreline.

Their results suggest that over a 50-year period, the costs of active beach renourishment are expected to be substantially less than the lost value associated with retreat. The authors suggest that the costs of renourishment would have to increase by a factor of four for retreat to be an economically preferable alternative, though they caution that cost estimates may vary greatly with assumed rates of erosion. Because of the characteristics of the study area, the majority of losses from retreat are those associated with residential real estate. Transition losses and losses associated with commercial structures are found to account for about 15% of total losses. Importantly, the coastal amenity value is found to be a statistically significant component of the economic value of at-risk property. For example, for an ocean-front house valued at $300,000, the ocean-front amenity is found to account for nearly $132,000 of the value. A bay-front house of similar value would owe $24,000 to its proximity to water and canal frontage appears to be worth \$63,000. The authors also suggest that for houses less than a half-mile from the beach, each 25 feet of distance from the coast is worth about \$1200 for a representative \$300,000 house. Because these amenity values can be assumed to transfer to properties further inland as a result of retreat, these results suggest that a simple subtraction of the current market value of at-risk real estate will grossly overestimate the costs of retreat and unimpeded shoreline recession. That is, while retreat can be expected to diminish or eliminate the market value of beachfront properties, the beachfront itself will always exist. Hence, properties that were once “one row back” will now be beachfront, and can be expected to increase in value. Nonetheless, given the current costs and technology associated with shoreline renourishment, retreat appears to be an unfavorable option from a market costs perspective.

Landry, Keeler and Kriesel (2003) explore the desirability of shoreline management alternatives by quantifying the economic impacts on coastal property owners who face risk of economic loss from erosion, the change in value of recreational uses of coastal areas that may be impacted by shoreline management and the costs of management. Effects on the natural environment (e.g. habitat loss or change) are not considered. Specifically, the incremental value of improved beach widths for coastal residents is estimated using hedonic analysis applied to a sample of 318 property sales on Tybee Island, GA. Including among the set of sales price determinants in the hedonic regression are beach width, distance from the beach, erosion risk, and the presence of erosion control structures. The measure of erosion risk was an indicator variable for property proximity to known high risk areas on the island. Beach width is found to be a statistically significant determinant of property value, with each one-meter increase adding \$233 to property value. Ocean-front and inlet-front amenity values are estimated to be of \$34,068 and \$87,620 respectively. Property values in high risk areas were estimated to be reduced by \$9,269.

Landry and Hindsley (2011) also apply the hedonic pricing method to real estate transactions for single-family residences in Tybee Island, GA, and measure the value of high- and low-tide beach and dune widths at nearby beaches, adjusted for changes in beach width due to sand replenishment activities. They find that beach and dune width have a statistically significant influence property value for properties located within 300 meters from the shore, but find no relationship for properties located further from the shore. Specifically, Landry and Hindsley estimate marginal willingness-to-pay for beach width for houses within 300 meters from the beach ranges from $421 to $487 for an additional meter of high-tide beach, or $272 to $465 for an additional meter of low-tide beach. The incremental value of dune width ranges from $212 to $383 per meter for houses within the 300 meter distance. When the estimation is extended to properties beyond the 300 meter distance, marginal values decrease. These authors also find that the value of ocean frontage is estimated to be between $39,000 and $75,000 and between $121,000 and $128,000 inlet frontage.

Gopalakrishnan et al. (2011) estimate the value of beach width to coastal property in ten coastal towns in North Carolina[1] using hedonic pricing models. When beach width is treated as an exogenous characteristic, the average increase in oceanfront property value is approximately $1,440 per additional foot of beach width. This value approaches zero for properties that are located more than 330 feet from the beach. When beach width is treated as endogenously determined[2] (i.e. property values are function of beach width and beach width, via nourishment activity, is a function of property value), the authors find that beach width likely accounts for a larger portion of coastal property value. Specifically, the coefficient on the (fitted) beach width variable is five times larger than in the exogenous specification, suggesting that the average increase in oceanfront property value is approximately $8,800 per additional foot of beach width, or a roughly 0.5 percent increase in value per 1 percent increase in beach width. The authors suggest that their results indicate that property values will be more sensitive to beach width when there is severe erosion and beach replenishment is used to stabilize the shoreline. Notably, unlike Landry and Hindsley (2011), Gopalakrishnan et al. (2011) find that the presence of dunes does not impact property values.

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[1] The sample of towns includes Carolina Beach, Kure Beach and Wrightsville Beach in New Hanover County. All other towns in the sample are in Carteret County or Dare County.

[2] This model is estimated via two-stage least squares, where geomorphological variables are used to instrument for beach width in the first stage, and fitted values of beach width are used in the price hedonic in the second stage.

5.1.3 Summary

There is a preponderance of evidence that property owners place considerable economic value on beach width. This value declines with distance from the shore. While some literature suggests that the existence of dunes has a positive impact on property values, the evidence to date is not clear. It is important to note, as articulated by Landry and Hindsley (2011), interpretation of specific value estimates such as those detailed above depends on individual perceptions of future resource quality. If conditions are expected to improve over time, value estimates should be interpreted as lower bounds on true value. If instead, conditions are expected to degrade, value estimates should be interpreted as upper bounds on true value.

5.2 Coastal Infrastructure

In addition to privately owned residential properties, coastal areas also contain physical capital in the form of public infrastructure (e.g. roads, water, electric, sewer). As with privately held capital, this public capital conveys economic benefits to society. Again, the value of these benefits to society can be considered a benefit of erosion control measures, or a cost associated with the failure to control erosion. It is important to note, as expressed in Parsons and Powell (2001), that some of the benefits associated with public capital accrue directly to property owners and will be capitalized into market values for associated real estate (e.g. water and sewer services), and thus included as part of damage avoidance estimates if the value of privately held coastal property is assessed. Yet, other aspects of value for these public assets are not amenable to market valuation, because the benefits derived from their use are not for sale (e.g. the value of public roads adjacent to public beaches). The only readily available market measure of value is that pertaining to new construction costs. That is, while there is no observable market value of what infrastructure is worth in terms of benefits conveyed to the public, we can observe or estimate the cost associated with its construction. As a case in point, in order to measure the potential value of terminal groins in terms of protecting public assets, the cost of constructing public infrastructure was used in NCCRC (2010).

While the procedural endorsement of the RC and CA approaches is understandable in light of the lack of an alternative proxy for value, as noted in the discussion above, the monetary estimates derived from these approaches should not be used without careful consideration. In particular, infrastructure replacement costs seem a tenuous measure of the value of protecting in-situ infrastructure in situations where a lack of protection induces sufficient erosion to eliminate any possibility of replacing that infrastructure. In circumstances where inundation (conversion of land habitat to water) removes the possibility of replacement, the cost of constructing infrastructure might best be considered an unrecoverable sunk cost. Costs that are germane to these situations would include expenses associated with physical removal of the infrastructure. However, when inundation necessitates replacement of lost infrastructure at an alternative location services in order to maintain service flows to properties that remain unaffected by erosion, replacement costs may be an appropriate estimate of at-risk value provided that they account for costs associated with right-of-way acquisition, engineering, permitting, and construction costs (in addition to removal of infrastructure).

5.3 Values Associated with Recreation and Tourism

5.3.1 Categories of value

Alternative actions for mitigating the effects of shoreline change are expected to impact the quantity and quality of recreation and tourism opportunities at the site of interest. Management action or inaction may also create effects on proximate sites or sites that are considered substitutes. These effects may include changes in beach area, the quality of sand, ease of access, the quality of the marine environment, the quality of scenery and the quantity or quality of habitats and species. Changes in economic values will be manifested in changes in the quantity or quality of extractive direct uses (e.g. catch-and-keep fishing), non-extractive direct uses (e.g. sunbathing, bird watching, walking/running, surfing, catch-and-release fishing), and passive uses (e.g. enjoying the aesthetics of a coastal area). In the case of beach nourishment and/or armoring, perhaps the most obvious of these changes is that associated with the amount of physical space available for recreation. Landry (2011) categorizes the economic value of changes in beach area as associated with improvements in scenery and aesthetics, allowing space for more users and decreasing congestion for existing users.

These categories of value are not mutually exclusive. Indeed, a single user can derive economic value from all of the above activities. Further, due to the non-rival and non-excludable characteristics of many of these uses, value derived by one individual does not preclude others from enjoying benefits as well. The most widely applied methodology for estimation of the economic value of changes in coastal quality as it pertains to recreation is the travel cost method, or its close cousin, random utility modeling. Applications of these revealed preference approaches are detailed in an extensive body of literature, some of which is reviewed below. Stated preference approaches such as the contingent valuation method and choice modeling may be appropriate in cases where benefits extend to aspects of value associated with more passive uses.

In addition to value accruing to direct users, additional economic impacts from changes in coastal quality may be realized by local businesses via changes in tourism demand and by governments via changes in tax revenues. Estimation of such economic impacts requires the use of economic impact analysis (input-output models) described earlier in this report. While the estimation of tourism multipliers and the economic impacts of discrete tourism-related events have received attention in the literature (e.g Dwyer et al., 2004; Frechtling and Horvath, 1999; Hodur and Leistritz, 2007), a recent review of the economics of coastal erosion by Landry (2011) finds a dearth of research regarding the economic benefits accruing to local businesses from beach management.

Finally, it is important to note that management alternatives involving shoreline retreat may not create losses in terms of foregone recreation and tourism opportunities. As discussed in Parsons and Powell (2001), if the shoreline is simply relocated further inland, with no changes to other beach characteristics, the welfare derived from recreationists can be assumed to be unchanged. More generally, to the extent that shoreline change does have an adverse effect on the quantity or quality of recreational opportunities, the degree of economic loss to users and associated businesses will depend upon the availability of substitute locations for such activities (Landry, 2011). If alternative sites are available, proximate and of similar quality, the economic losses associated with diminished quality at one site may be mitigated via substitution.

Clearly, the economic value from coastal recreation and tourism is multi-faceted and involves numerous user groups. A comprehensive empirical estimation of quality-induced changes in values associated with recreation is not straightforward, and should be site-specific entailing multiple valuation approaches.

5.3.2 Examples from the literature

The literature pertaining to the economic value of coastal recreation is vast. This literature includes estimates of the value of access, typically addressed via revealed preference methods, as well as the value associated with changes in site quality, which is more commonly assessed via stated preference techniques. We do not attempt to provide a comprehensive review of this literature, but rather try to highlight particular studies that may be germane to the issues at hand.

Bin et al. (2005) apply the travel cost method to estimate the economic value of beach recreation in North Carolina. Data were collected at seven beach sites in the state, including Topsail Island and Wrightsville Beach. Value estimates range from $11 to $80 for day trips and between $11 and $41 for overnight trips. There is notable variation in value estimates across sites, with higher values found for beaches that are inaccessible by automobile or are not as well-known as other beaches in the sample. The authors speculate that the perception of exclusivity may influence the recreational value of beaches and suggest that unique site characteristics and user preferences for different types of experiences are important determinants of value.

In a contingent valuation analysis of beach renourishment in the Cape Hatteras National Seashore, N.C., Judge, Osborne and Smith (1995) find that average willingness to pay for beach renourishment is approximately $178 per person per year. This value was a positive function of anticipated future visitation and is inversely related to prior experience at the site. Willingness to pay also decreases with distance from the site for those users with no prior experience visiting Cape Hatteras and is a positive function of education level and the attitude that beach towns suffering from storm erosion should receive additional federal assistance.

Whitehead et al. (2008) use the travel cost method and a combination of revealed preference and stated preference data to estimate changes in recreation demand at 17 beaches in southeastern North Carolina that would occur with improved parking and beach nourishment. The study area included numerous beaches in Carteret, Pender, Onslow, New Hanover and Brunswick Counties. Regarding beach nourishment, respondents were informed that beach nourishment projects would be performed at least once every 3 to 5 years for a 50-year term for the purpose of shore protection and enhanced recreation opportunities, and average beach width would increase by 100 feet. A majority of respondents (58%) expressed support for the beach nourishment policy, and most respondents (85%) felt that the stated beach nourishment policy would be effective in maintaining beach width. Yet, some respondents (21%) were satisfied with current beach widths and some (18%) felt that beach width should not be altered by people. Enhanced beach width was found to increase total net gains to beach visitors by approximately $7 per person per trip and roughly $68 per person per year.

5.4 Values Associated with Coastal Species and Habitats

As is the case with empirical explorations regarding the economic value associated with coastal recreation, the literature on the economic value of species and habitats is extensive. Howarth and Farber (2002) provide important background reading regarding the economic valuation of ecosystem services, and note the importance of constructing monetary measures of economic wellbeing that account for non-market values held by people. These non-market values include existence values pertaining to species and ecosystems. The authors also highlight the importance of accounting for values held by a range of stakeholder groups rather than value held by a “representative” individual. A review of the literature provided by Spurgeon (1999) suggests that use and non-use benefits derived from coastal ecosystems are substantial. These ecosystems provide an array of valuable services that result in economic benefits to the public at large. Barbier et al. (2008) note the importance of considering nonlinearities when accounting for changes in coastal ecosystem service flows. Specifically, they note that changes in coastal ecosystem services do not necessarily respond linearly to changes in habitat size. This implies that valuation of coastal ecosystem services should not be based on simple linear extrapolations of lost habitat to point estimates of monetary value.

In the case of wetlands, ecosystem services include filtration, storage, and detoxification of residential and agricultural wastes and mitigation of pollution and nutrient-laden runoff into receiving water bodies (Stedman and Dahl, 2008). Wetland preservation can be viewed as a cost-saving measure for communities as these water-quality services can involve considerably lower costs than community or municipal water treatment alternatives (US EPA, 2006). By absorbing and storing flood waters, wetlands can also serve as a natural buffer protecting adjacent real estate from the effects of rising surface waters during storms. Similarly, dune habitats provide important storm-protection services for coastal land and property. Wetlands and dunes also provide important transitional habitat between aquatic and terrestrial environments for resident and migratory wildlife. Wetlands serve as critical nursing areas for marine organisms, including the majority of fish and shellfish species harvested in the U.S. (US EPA, 2006). The quality and abundance of coastal ecosystems are therefore directly related to the health of fish and wildlife stocks (Stedman and Dahl, 2008).

The existence of dunes and wetlands in a community may enhance property values for storm protection benefits, aesthetics and through improved opportunities for recreation activities such as hiking, bird watching, and photography. Wetlands may be considered a disamenity if they are associated with odors, insects or undesirable wildlife interactions.

Several studies have attempted to estimate the economic impact of proximate wetlands on land values using the hedonic pricing method. Generally, these studies suggest that the effect of wetlands on property values depends on the type and character of the wetland. For example, in an examination of property values in rural Florida, Reynolds and Regalado (1998) find that proximity to scrub-shrub and shallow pond wetlands has a positive impact on property values, while proximity to emergent palustrine wetlands may have an adverse effect. In mainland North Carolina, Bin and Polasky (2003) find that the open and sparsely vegetated nature of coastal wetlands provide a value-enhancing amenity while more densely forested inland wetlands do not, and may in fact decrease property values.

Numerous studies employing stated preference methods find substantial economic value associated with recreation, wildlife habitat, flood control, and improved water quality from wetland services (McConnell and Walls, 2005). Woodward and Wui (2001) review the results from 39 empirical studies, and find that type of wetland and method of analysis has substantial effect on estimated wetland values, noting that only imprecise estimates of wetland values can be garnered from the literature. Hence, it is reasonable to conclude that wetlands are an important source of economic value to surrounding areas, but without case-specific empirical analysis, a reasonable approximate of the magnitude or distribution of that value is not feasible.

Spurgeon (1999) provides an overview of the economics associated with coastal habitat rehabilitation and creation, including a review of the relevant literature. The author notes that the costs associated with habitat rehabilitation or creation costs vary widely between and within ecosystems. The two studies that pertain to dune habitats suggest that rehabilitation costs may range from approximately $19,000 to $25,000 per hectare.[3]

Numerous studies are available that pertain to the economic value of species and species protection. Shogren et al. (1999) provide useful background reading. Loomis and White (1996) provide results from a meta-analysis of the economic benefits of rare and endangered species. Whitehead (1993) estimates willingness to pay for preservation of coastal non-game habitat and loggerhead sea turtle nesting habitat in North Carolina using the contingent valuation method and a sample of 600 North Carolina residents. Average annual willingness to pay is approximately $11 for the loggerhead sea turtle program and $15 for the coastal nongame wildlife program. In addition to generating estimates of the economic value of coastal habitat associated with species protection, this work highlights the importance of accounting for uncertainty when estimating the economic value associated with threatened or

[3] The latter value pertains to a 2.5 ha dune rehabilitation project in Scotland and includes costs associated with replanting dune grass, providing fencing for trapping sand and installing gabion revetments. Additional maintenance costs for the project are noted as less than $1,000 per year. The former value pertains to a 17.8 ha dune rehabilitation project in Monterey, CA.

endangered wildlife populations. The author notes that failure to account for uncertainty with regard to the continued existence of the resource as well as uncertainty pertaining to demand and preferences may result in inappropriate benefits estimates.

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APPENDIX P

STORM RESPONSE SIMULATION

Delft3D Storm Response Simulations
With and Without a Terminal Groin

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November 12, 2012

Introduction

A calibrated, depth-averaged Delft3D model was utilized to predict the physical performance of the terminal groin following passage of a low-frequency tropical storm event. The model was run for both with- and without-terminal groin conditions in order to draw relative conclusions on storm response. Both scenarios include the placement of approximately 1.2 Mcy of beach nourishment and simulate beach conditions following or concurrent with project construction. Spatial distribution of the beach fill varied between scenarios according to specific project needs. Both models consider the existing sand-filled geotextile tube groins. The storm-response results suggest that the terminal groin improves the performance of the placed beach nourishment sand without causing significant negative impacts to the downdrift shoreline.

The terminal groin is modeled as “leaky” using porous plates which are by definition infinitely high, semi-permeable numerical structures. The permeability of porous plates is numerically controlled by a friction term which was set to 4.5 for these simulations, roughly representing a level of permeability between about 10 and 30 percent. The existing tube groins are described as thin dams in the model, which act as impermeable, infinitely high barriers to sediment transport.

Storm conditions simulated in the model are similar to those identified during the June 10-14, 1996 passage of Hurricane Bertha. The model does not seek to expressly model Hurricane Bertha, and damages caused by local high winds and inland flooding are not described in the model. Rather, the tropical event simulated herein is akin to a Bertha-like event. Hurricane Bertha was, at its peak intensity, a Category 3 storm which made landfall as a Category 2 storm in the immediate vicinity of Bald Head Island. Hurricane Bertha’s track is mapped in **Figure 1**.

Waves, Water Levels, and Bathymetry

The storm model was run in real time, for the 4 day period June 10 - 14, 1996. A time series detailing significant wave height, wave period, wave direction, and wind velocity for this time period were obtained from data published by the U.S. Army Corps of Engineers Wave

Information Studies (WIS). Specifically, data from offshore WIS station 63320 were used. The location of this station is shown in **Figure 1**. WIS station 63320 is very near both the seaward row of the numerical wave grid and the NOAA buoy used to generate input conditions for the calibrated long-term morphological model. As such, the WIS time series data were input directly into the model as-is. The offshore wave time series is plotted in **Figure 2**. Hurricane Bertha represents the third largest wave heights in the 20-year WIS record covering the period 1980-1999.

A time series of measured water levels for this period was specified using tide data collected at Oak Island, NC. Hourly tide measurements were obtained from NOAA's National Ocean Service station 8659182, which is located in the Atlantic Ocean off Oak Island, NC. The hourly water level time series used for model input is plotted in **Figure 3**.

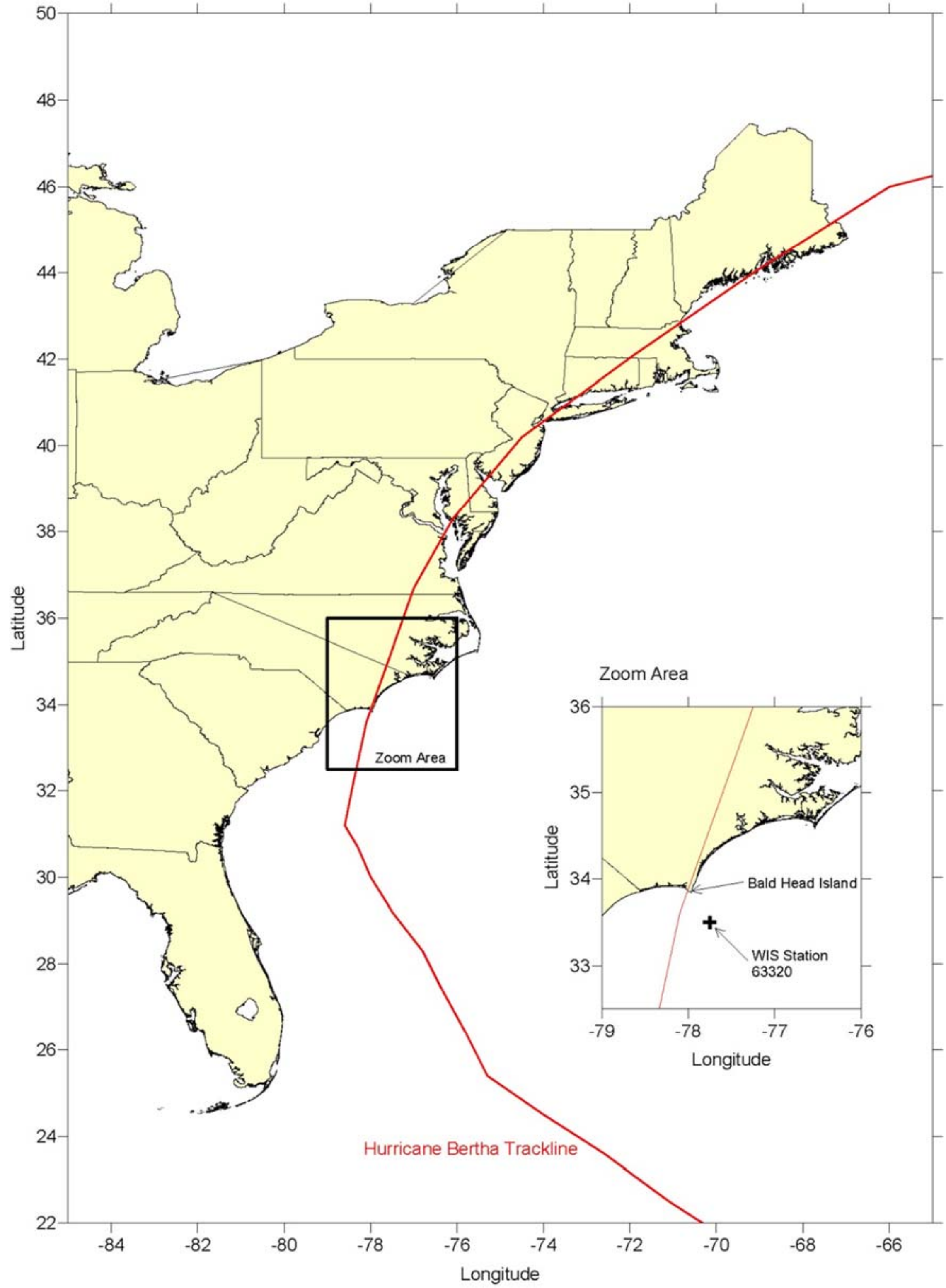

Figure 1: Track of Hurricane Bertha (1996).

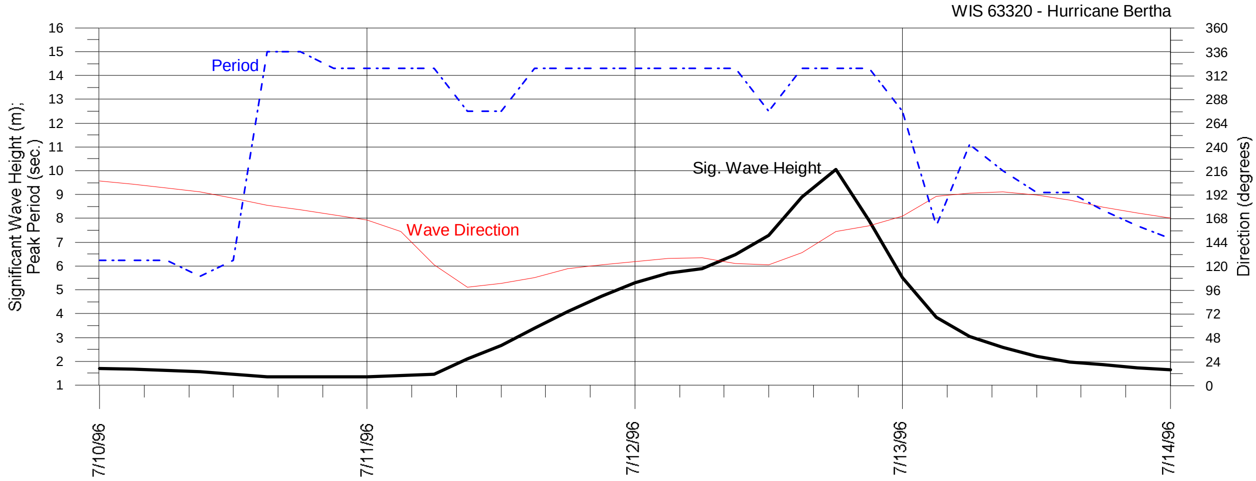

Figure 2: Input offshore wave time series obtained from WIS Station 63320.

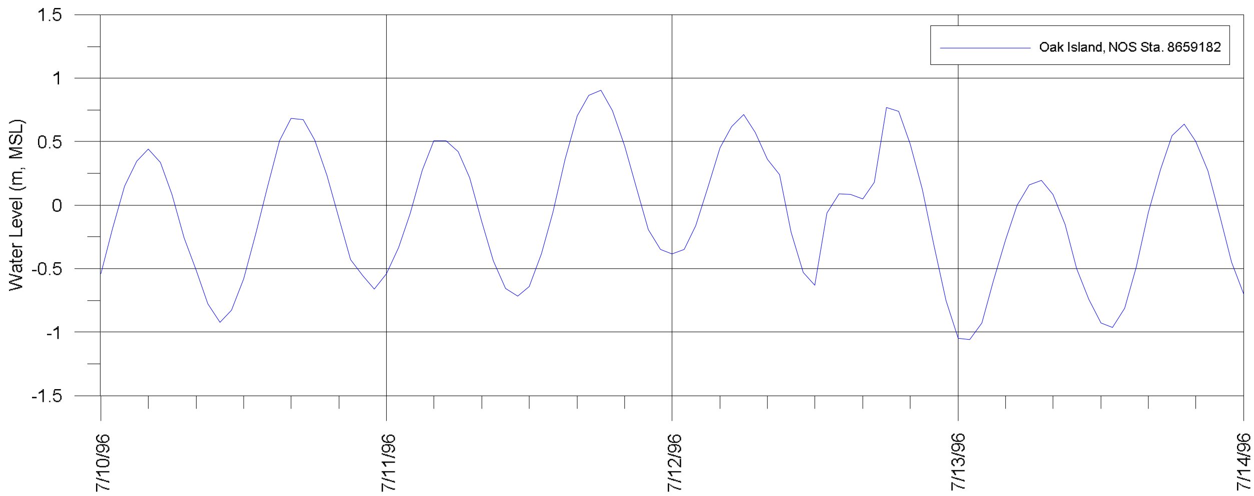

Figure 3: Input water level time series obtained from NOS Station 8659182, Oak Island, NC.

Figure 4 depicts the input bathymetry for the beach fill only condition (without terminal groin). This modeled scenario represents a typical sand placement (disposal) project along Bald Head Island. The project includes placement of about 1.2Mcy of sand extending from the Point eastward to about Station 166+00. A typical nourishment event of this volume will bury, and deactivate, the existing tube groins. The beach fill only scenario was run as a baseline condition in order to form the basis for relative comparison to the terminal groin (with fill) simulation.

Figure 5 plots the input bathymetry for the semi-permeable terminal groin scenario. The modeled bathymetry includes placement of a similarly sized beach fill placement project. The 1.2Mcy nourishment is distributed from the terminal groin to about Station 130+00 where it begins to taper into the existing profile. The distribution of the fill increases in sectional density towards the west in order to pre-fill the fillet along the updrift side of the terminal groin.

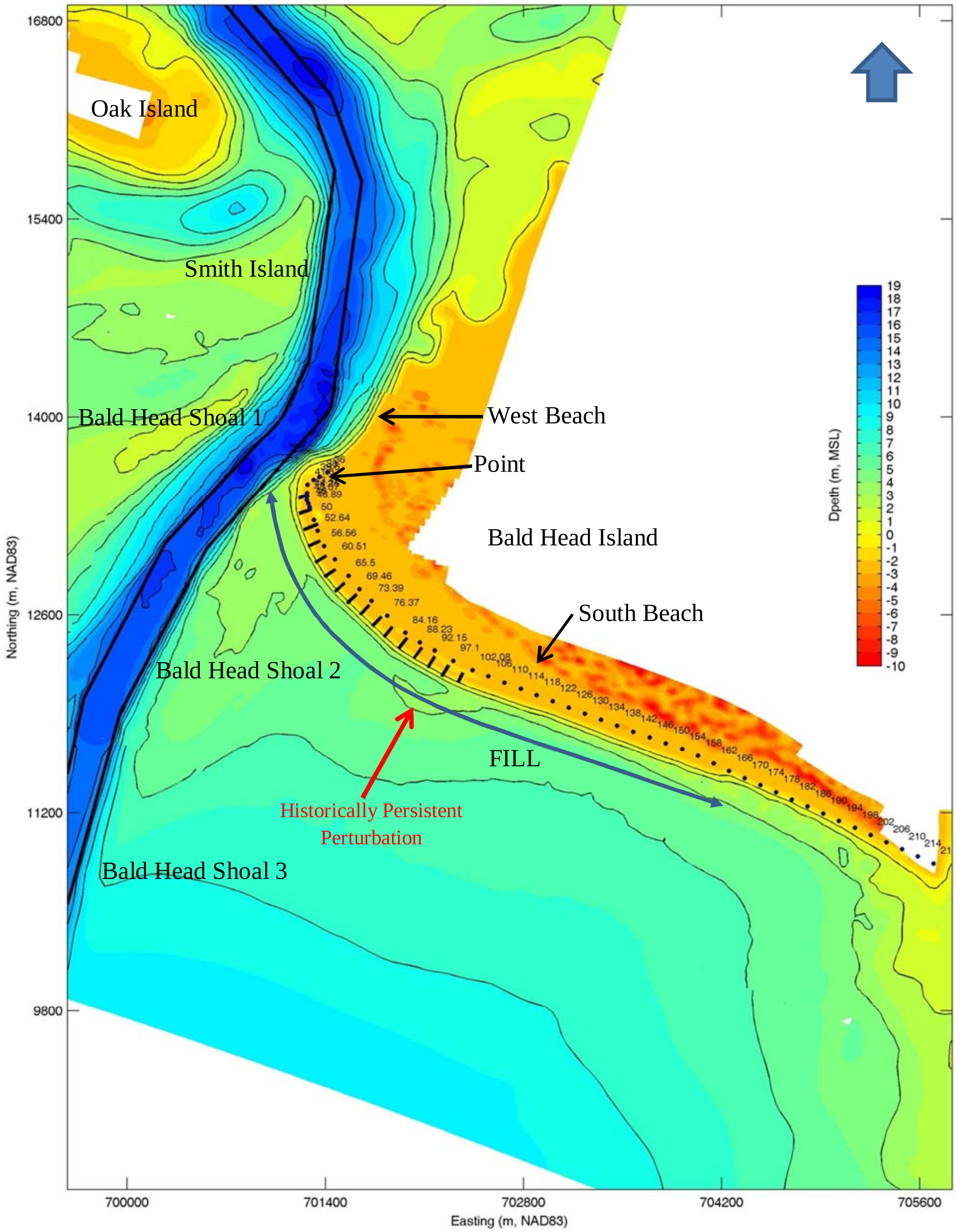

Figure 4: Nearshore bathymetry used for model input in the beach fill only simulation.

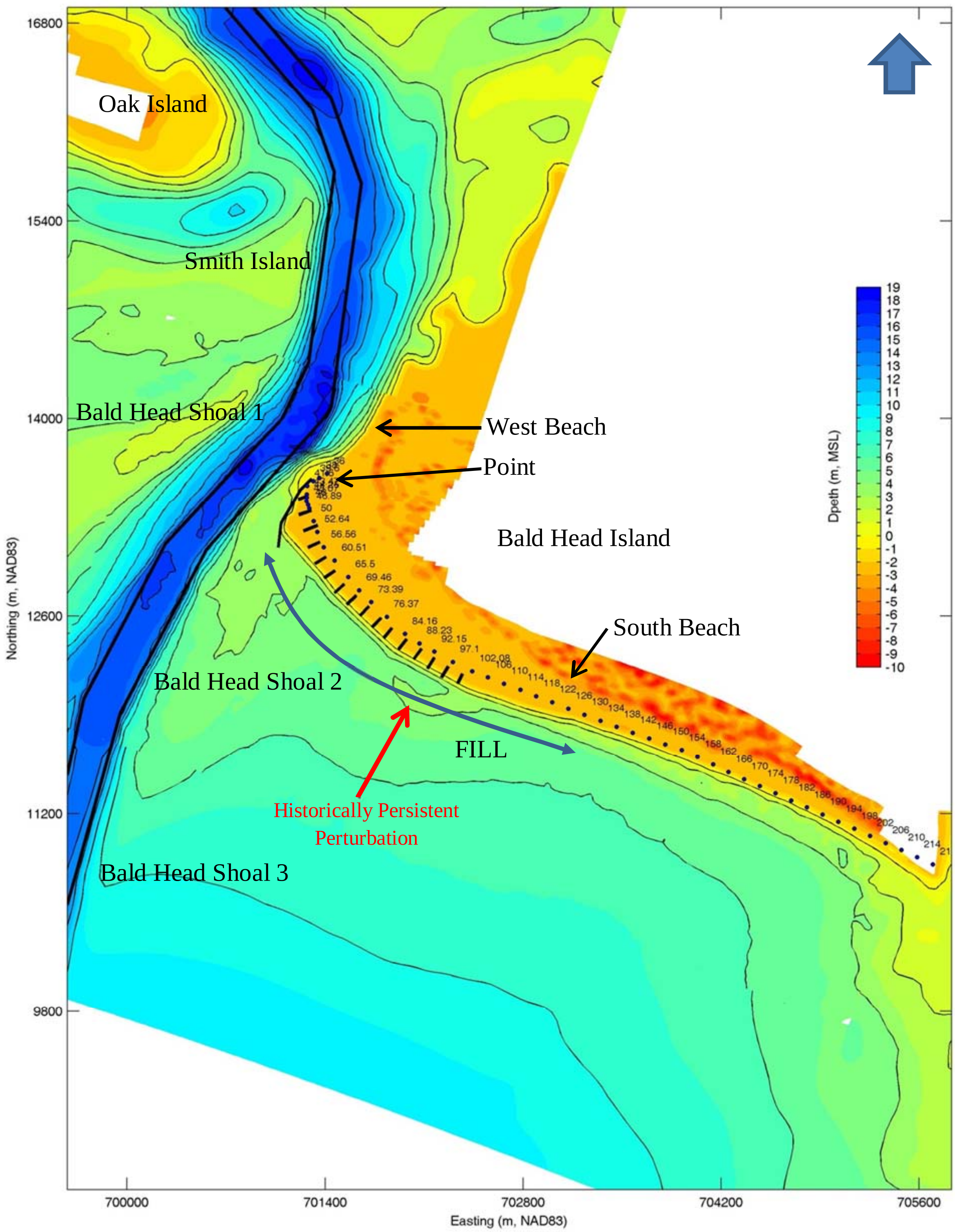

Figure 5: Nearshore bathymetry used for model input in the semi-permeable terminal groin simulation.

Model Results

Figures 6 and **7** present cumulative erosion and sedimentation patterns predicted for both without- and with-terminal groin simulations, respectively. Blue shading represents sedimentation (accretion) whereas red/yellow shading represents erosion (seabed deflation). The vectors on each plot describe mean total sediment transport over the four day simulation and are scaled identically for both with- and without-terminal groin conditions. **Figure 8** directly compares cumulative erosion and sedimentation magnitudes without mean transport vectors for increased readability. The beach fill only condition is shown on the top pane of the figure with the terminal groin result below.

Under both scenarios there is a storm-induced acceleration of transport, and subsequent erosion, immediately updrift (east) of the geotextile groin field. This is suggestive of an erosional "hot spot" which results in transport off the beach with deposition just offshore of the eastern tube groins. This pattern has been verified by field observations and is generally accurately predicted by the model. Further, the bathymetric record suggests a persistent sandy, subaqueous perturbation extending seaward at this location (demarked by a red arrow in **Figure 4**) which precedes the tube groin field and likely evidences previous erosion/accretion events like that described above.

Both simulations predict storm-related cross-shore equilibration of the south-facing (South Beach) shoreline. This is reflected by the blue shading immediately offshore of the intertidal beach. It is characteristic of sandbar formation commonly measured by survey along Bald Head Island. The western extent of sandbar formation differs between the two results, however. In the beach fill only condition, sediment is not deposited in the nearshore zone in the far western reaches of the tube groin field. The shoreline here is oriented nearly north-south and the model indicates accelerating erosion towards the inlet with no formation of a stabilizing bar. Eroded sediments are deposited into the inlet channel or large shoal off the Point and are ultimately lost from the island's littoral system.

With the terminal groin in place, however, there is relatively uniform sandbar formation throughout the project area along with predicted impoundment eastward of the structure. There is very little sediment movement predicted in the lee (west) of the terminal groin, excepting a localized area of erosion associated with a northward push of the existing Point sediments.

Both simulations predict storm-induced shoaling within the navigation channel, principally in the central portion of the Bald Head Shoal 1 cut. This shoal feature is much more spatially expansive under the fill only condition. The addition of the terminal groin appears to result in localized focusing of transport off the seaward end of the structure towards the channel. This process appears to greatly reduce the migration of the Point shoal towards the channel during the simulated storm event but results in some level of temporal scour at the seaward tip of the terminal groin, as expected.

In the beach fill only scenario with no terminal groin, the model indicates an acceleration of erosion throughout the western end of the tube groin field. The seabed erosion accelerates further north of the last groin. This suggests a strong possibility for failure of said groin, particularly considering the fact that the model describes conditions immediately after fill placement when the beach is technically at its least vulnerable. Increased erosion and recession along the Point is wholly consistent with observations from monitoring conducted over the last 10 years.

The simulations additionally suggest that the addition of the terminal groin results in an overall lower rate of sediment transport along the western South Beach shoreline of Bald Head Island. This is primarily associated with a reduction of the shoreline angle relative to the incident wave direction via prefilling the terminal groin. The apparent eastern extent of the "hot spot'' at the east end of the groin field is potentially reduced by about 2,400 feet (+/-) under the with-terminal groin scenario (though some of this apparent benefit may be related to differences in the fill sectional densities between the two alternatives). The Point continues to migrate northward under both with- and without-terminal groin scenarios via erosion of its southern beach and subsequent deposition of this sediment further north, towards West beach (see **Figure 8**).

An accounting of sand lost within the respective areas of fill placement suggests that the addition of the terminal groin reduces net volume losses within the construction template by about 57 percent over the beach fill only condition (without terminal groin). More specifically, the construction template in the fill areas lost, in the net, about -97,400 cy without the terminal groin versus approximately -55,350 cy with the terminal groin. The fate of the higher losses from the beach fill only scenario is predominantly manifest as deposition north and west of the Point. Previous numerical analysis and physical monitoring observations suggest that this sand is effectively lost from the beaches' littoral system to the navigation channel.

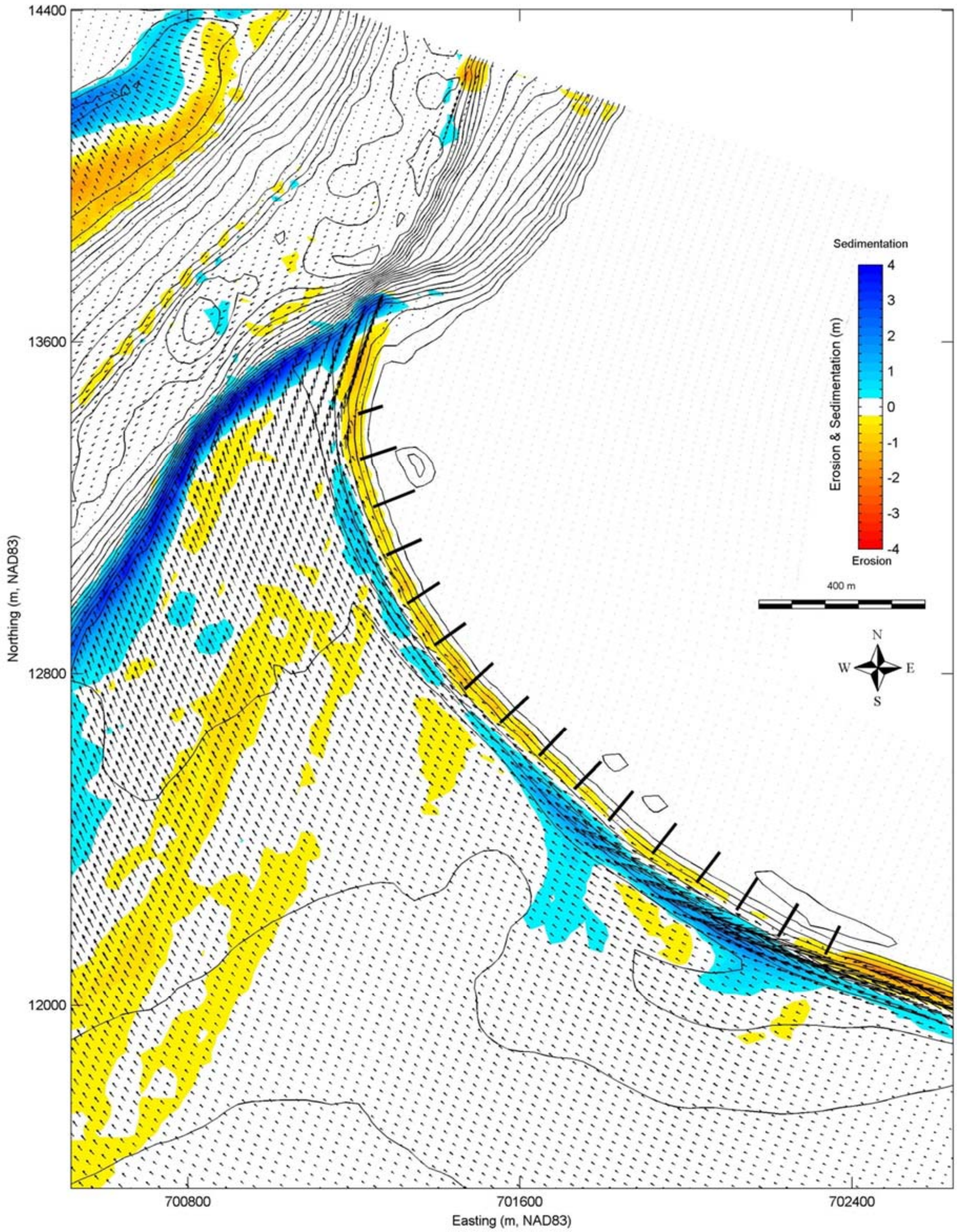

Figure 6: Cumulative sedimentation and erosion patterns and mean transport directions for the beach fill only condition following a Bertha-like tropical storm event.

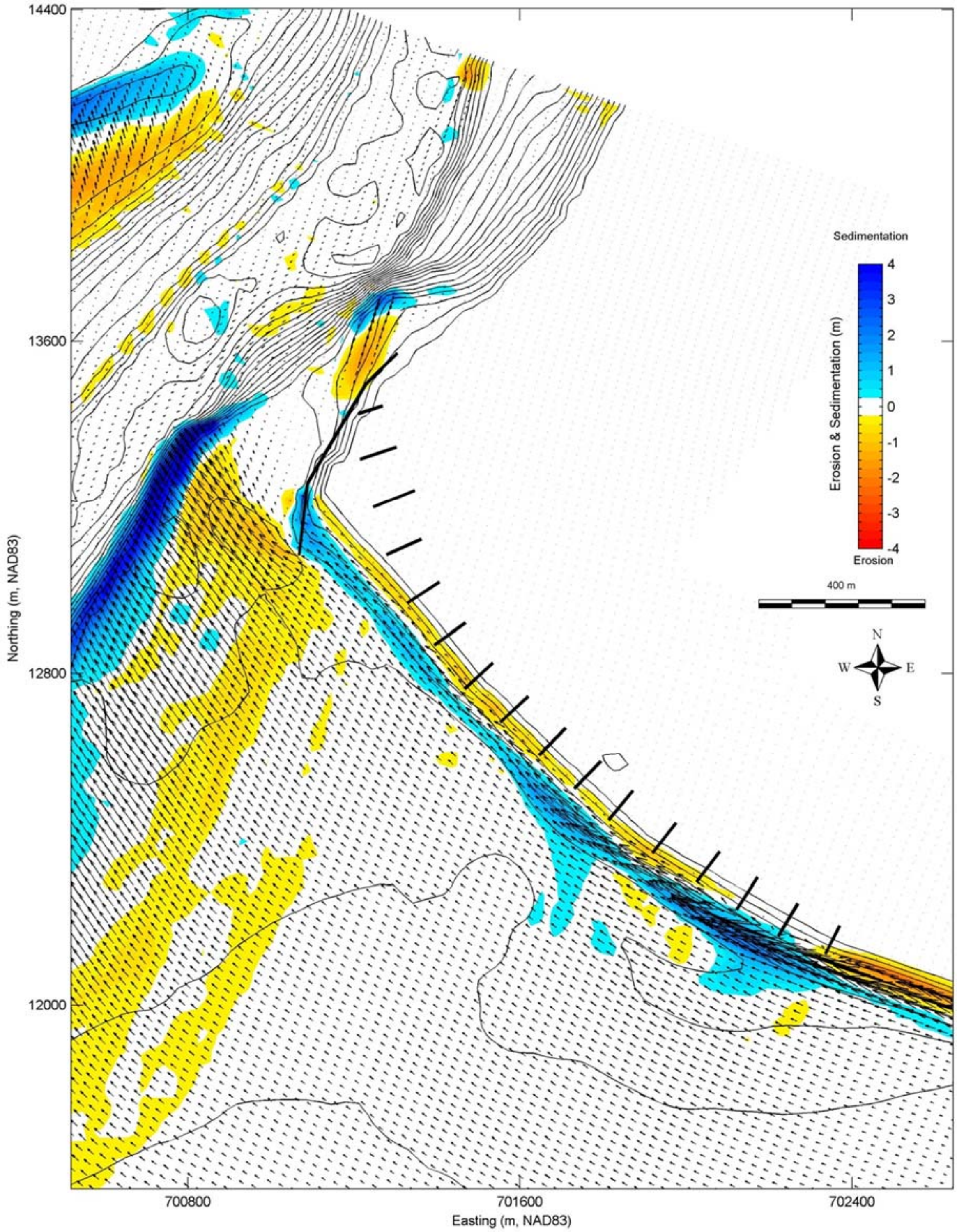

Figure 7: Predicted cumulative erosion and sedimentation patterns and mean transport directions for the with-terminal groin simulation following a Bertha-like tropical storm event.

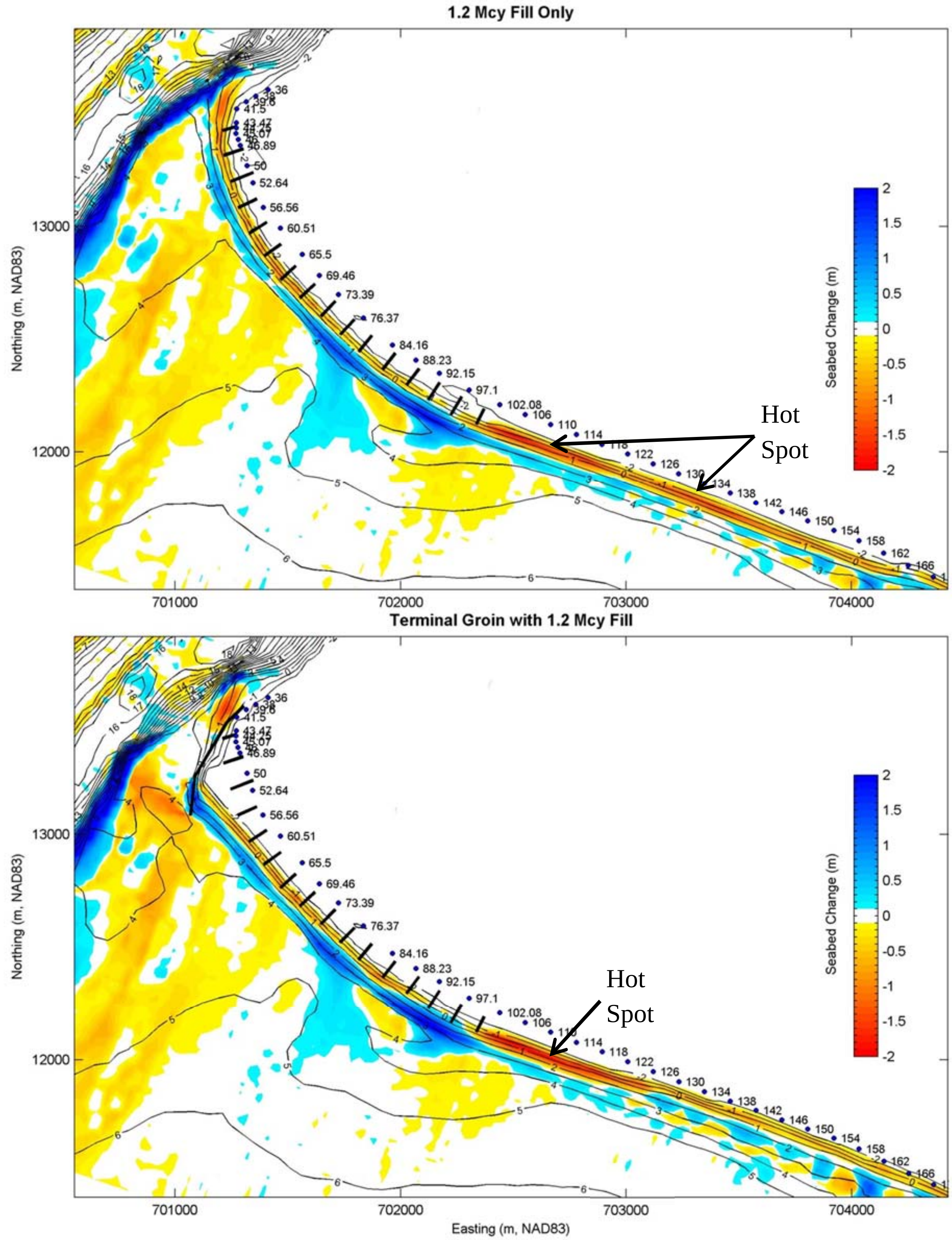

Figure 8: Predicted cumulative erosion and sedimentation patterns following a Bertha-like tropical storm event. Upper – without terminal groin; lower – with terminal groin.

The model results indicate an increase in sediment transport at the seaward tip of the terminal groin along with some scour at the tip of the jetty – as intuitively expected during the storm event. Longer term model simulations performed for the broader analysis of the terminal groin indicate a marked decrease in channel shoaling following construction of the terminal groin, particularly within the Bald Head Shoal 1 cut. The results of this storm simulation indicate that the apparent increase in transport towards the channel (at the structure's seaward end) is beneficially offset by a decrease in transport into the channel at the Point. The latter has been documented as an area of historically persistent shoaling.

Figure 9 plots the difference between the post-storm (final) bathymetries predicted under with and without terminal groin conditions. Yellow and red shading in the figure indicates areas where the seabed is lower due to the terminal groin and its corresponding beach fill, while blue shading represents a raised seabed attributable to the terminal groin and its fill. The dark blue fillet in the upland -- east of the terminal groin -- includes the beach fill sand that was initially added to pre-fill the terminal groin. Further seaward, the blue shading represents beneficial impoundment of material and/or deposition owing to reduced sediment transport rates along South Beach following terminal groin installation. The direct impoundment effect of the terminal groin appears to extend eastward to about Station 66+00 thence tapering off in magnitude until about Station 76+37. Much of the yellow shading in the lee (west and north) of the terminal groin represents reduced accretion and shoaling relative to the beach-fill only (no groin scenario. The model does suggest increased erosion along a small area at the landward end of the terminal groin, which is not unexpected. This is manifest as a modest increase in shoreline recession. The model results do not indicate any volume changes attributable to the terminal groin along West Beach, north of the Point.

As noted above, some of the differences in the project performance depicted in **Figure 9** reflect requisite differences in the initial beach fill geometry for the with- and without-terminal groin scenarios. **Figure 10** numerically removes these differences. That is, Figure 10 depicts the residual differences in the post-storm seabed elevations between the with- and without-terminal groin cases after accounting for (subtracting) the differences between the two cases' initial beach fill elevations. Again, yellow shading indicates areas where the post-storm seabed is lower due to the terminal groin – and blue shading indicates areas where the post-storm seabed is higher due to the terminal groin – relative to the beach fill only (no terminal groin) scenario. The direct effects of the terminal groin upon the beach and beach fill are evident in **Figure 10**. There is a net, substantial increase in sand volume retained along the west end of South Beach – within 750 meters updrift of the terminal groin. This is manifest as a reduction in erosion along the shoreline (blue band closest to land), cross-shore equilibration of sand placed and retained near the terminal groin (yellow/blue band in the middle of fillet), and some accumulation of sand at the terminal groin (blue band near the end of the terminal groin). At the same time, there is a reduction in sand volume that would otherwise accumulate along the Point and seabed nearest the channel (yellow/red areas westward and north of the terminal groin). Overall, reclaiming the shoreline under the terminal groin scenario results in a seaward shift of the beach equilibration process.

Figure 11 compares the approximate post-storm mean sea level (MSL) contours for with- and without-terminal groin conditions. Because Delft3D is a volume based model, the precise location of a tidally referenced shoreline should not be interpreted literally. That is, the Delft3D model predicts changes in seabed volumes, not shoreline locations. Comparatively speaking, the model results indicate the shoreline along South Beach remains much further seaward and more stable with the terminal groin relative to the beach fill only condition. This is attributable to the differences in placement of the initial nourishment and the ability of the terminal groin to quasi-stabilize the sand fill while impounding additional material.

The model suggests a localized difference in post-storm shoreline position at the Point, in the lee of the terminal groin. Specifically, a modest amount of additional Point shoreline recession is predicted under the with-terminal groin condition. This additional shoreline recession is not predicted to propagate north of the Point onto West Beach; that is, the predicted post-storm shorelines are identical along this area. The model suggests that post-storm net volume loss associated with the reduction in sediment supply to the Point under the leaky terminal groin scenario is about -5,100 cubic yards.

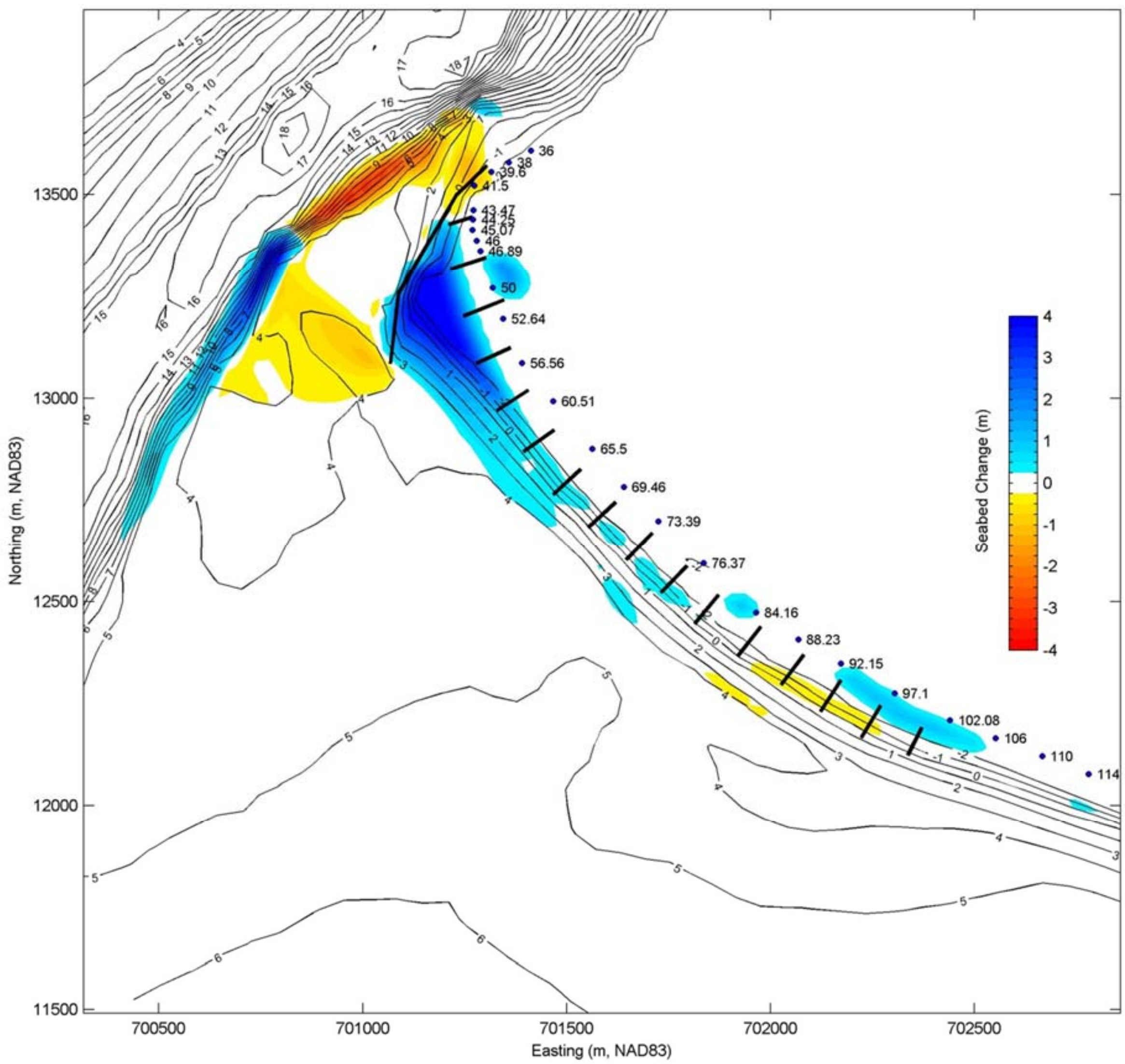

Figure 9: Predicted seabed differences attributable to the terminal groin following a Bertha-like storm event -- computed as the difference between post-storm (final) bathymetries for with- and without-terminal groin conditions. The effects of different initial beach fill geometries are included in the figure. Post-storm bathymetric contours are shown for the with-groin scenario and indicate that sediment was impounded by the terminal groin during the simulation.

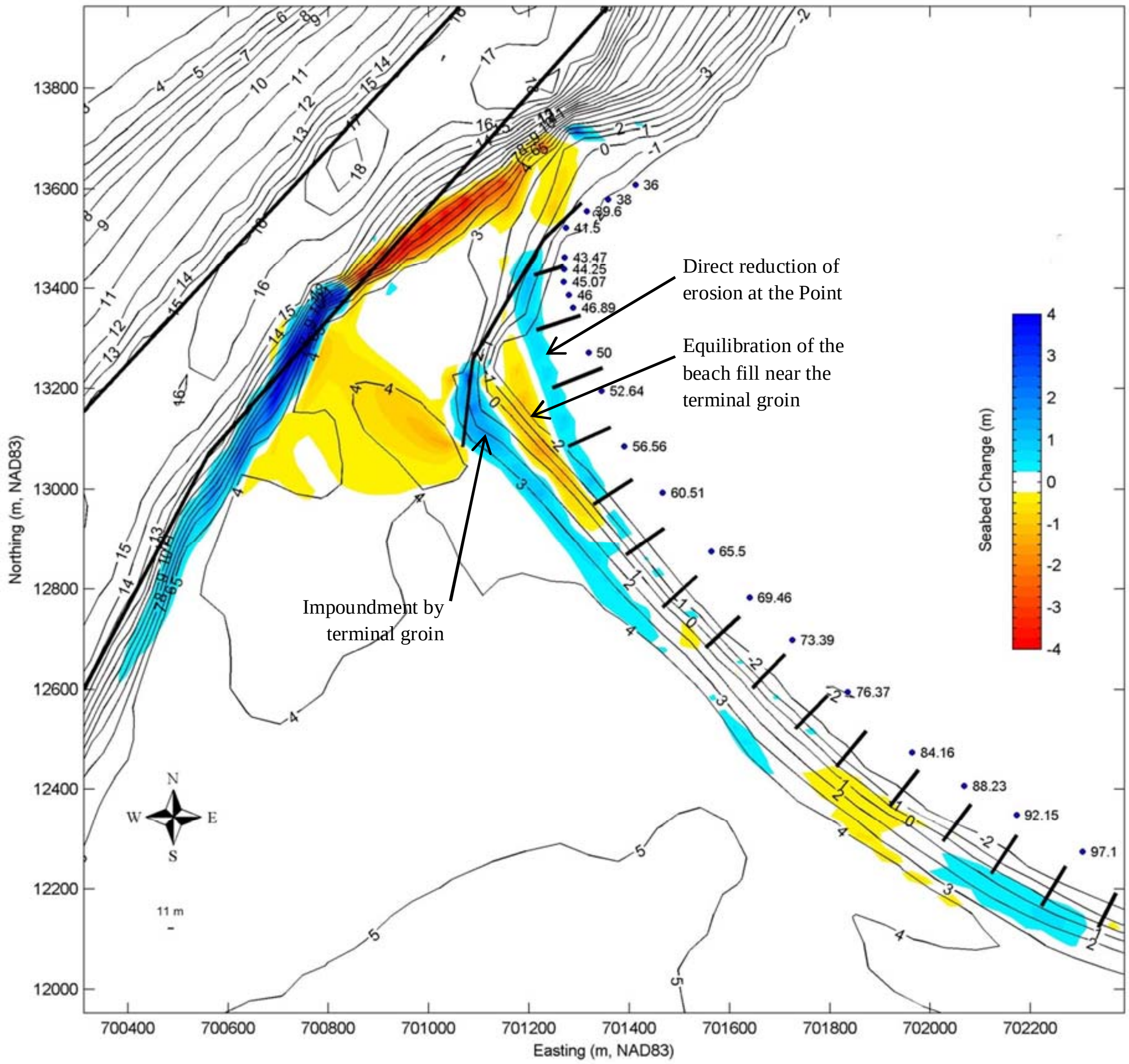

Figure 10: Predicted changes in the seabed attributable to the terminal groin following a Bertha-like storm event. Differences in the initial beach nourishment (between "with-groin" and "no terminal groin" scenarios) have been numerically removed from the results.

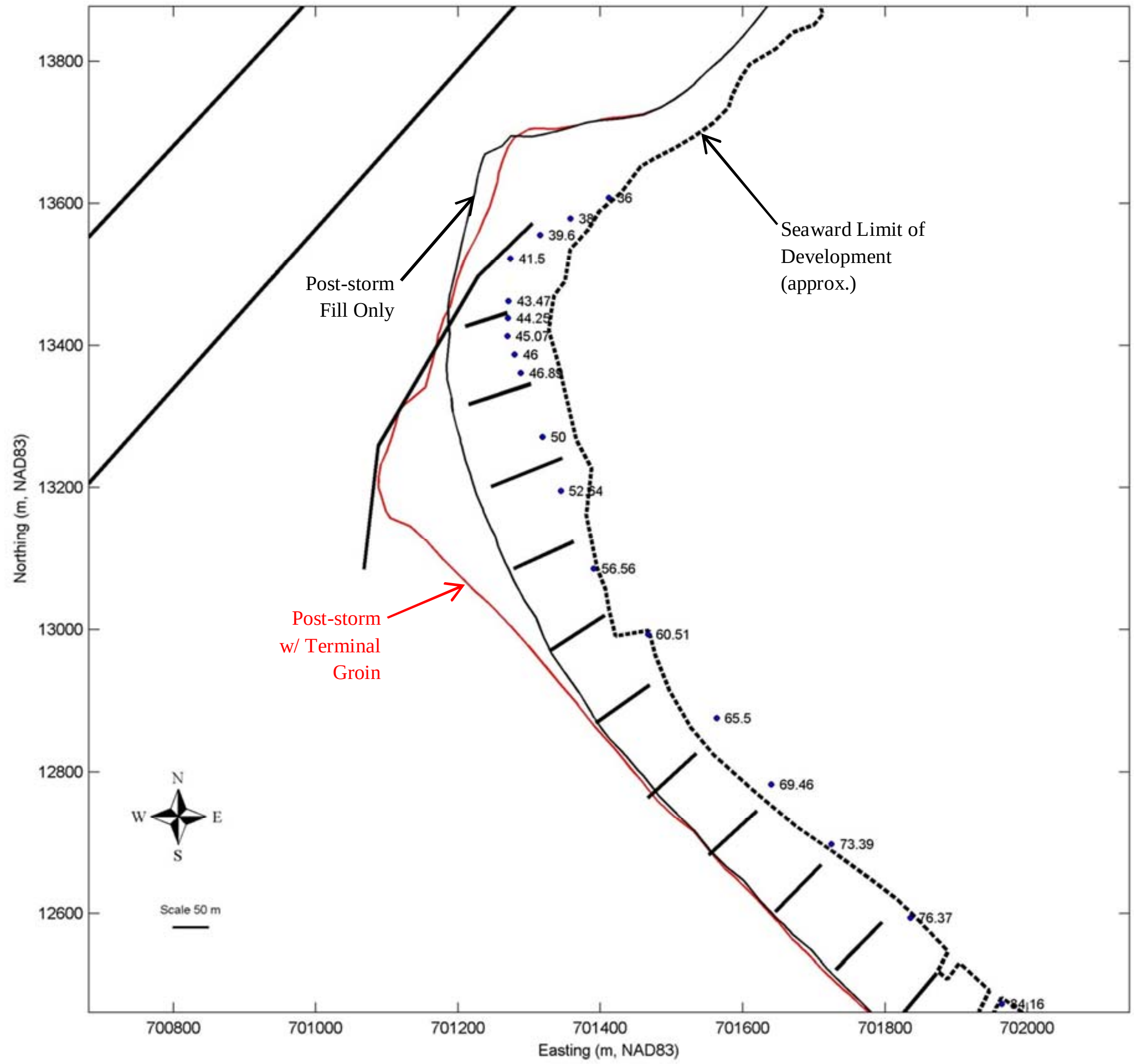

Figure 11: Approximate MSL shoreline response to a Bertha–like event for with- (red line) and without-terminal groin (black line) conditions.

Effect of Tube Groins

The scenarios described above were rerun to simulate the removal of all of the existing sand-filled tube groins along western Bald Head. The results were then directly compared to the "with tube groin" scenarios (described above) in order to determine the relative effect of the tube groins. All other parameters and initial conditions in the model remain the same. **Figure 12** compares the cumulative erosion and sedimentation patterns predicted under with and without tube groins for the beach fill only scenario (i.e., 1.2Mcy initial beach fill and no terminal structure). Vectors in the plots are identically scaled in both panes and represent mean total transport. An analysis of the volume change along Bald Head suggests that without the tube groins, the project is predicted to experience a net loss of approximately -105,300 cy within the limits of fill placement. In comparison, with the tube groins in place, the same fill limits were predicted to experience a net loss of about -97,400 cy, with the differences representing a direct benefit of the tube groins. Additional fill volume retained by the groin field is expectedly subtle in this simulation for two primary reasons:

- The initial bathymetry used as model input describes a post-nourishment condition which mostly buries the groin field thereby limiting the groins' exposure to incident waves, and
- The storm simulation is short in duration yielding less time for 'activated' structures to trap sediment once exposed by erosion.

That is, initiation of the storm simulation on an eroded beach (where the tube groins are initially exposed) would result in a proportionally larger effect (benefit) from the groins. Under this condition, the groins' ability to interrupt the alongshore transport of sediment would likely increase the downdrift erosion attributable to the groin field as well. The latter process is presently observable at the Point, immediately west of the tube groin field.

Figure 13 plots the difference between the post-storm (final) bathymetries predicted under with and without tube groins for the nourishment only condition. Yellow and red shading in the figure indicates areas where the seabed is lower due to the tube groins, while blue shading represents a raised seabed attributable to the tube groins. The results suggest a minimal lowering of seabed elevation at the Point and a modest decrease in material shoaling the channel due to the presence of the tube groins. Near the eastern limit of the groin field, however, the model predicts more significant differences in seabed elevation attributable to the tube groins. The model results suggest that the groin field physically interrupts the predicted nearshore erosional gradient extending east of about Station 92+15 (a historically erosional area), see **Figure 12**. The result is a predicted elevation increase across the easternmost three tube groins; i.e., retention of westerly-driven transport. The apparent seabed deflation immediately adjacent (west of) Station 92+15 due to the tube groins represents a decrease in sedimentation in the area where eroded sediments are deposited in the without tube groin model (Sta. 76+37 to 92+15).

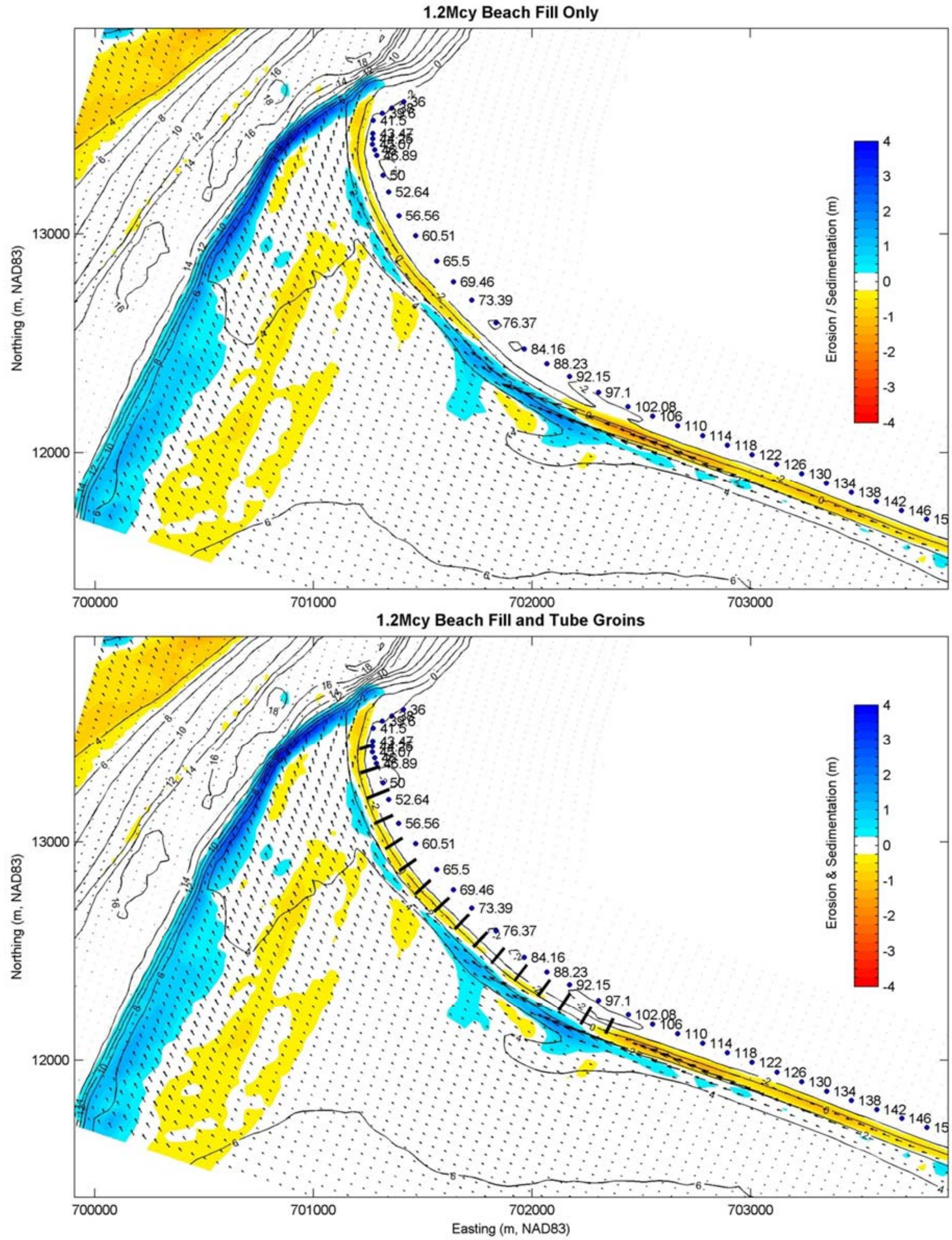

Figure 12: Comparison of predicted erosion/sedimentation patterns considering with and without the tube groins under the fill only scenario.

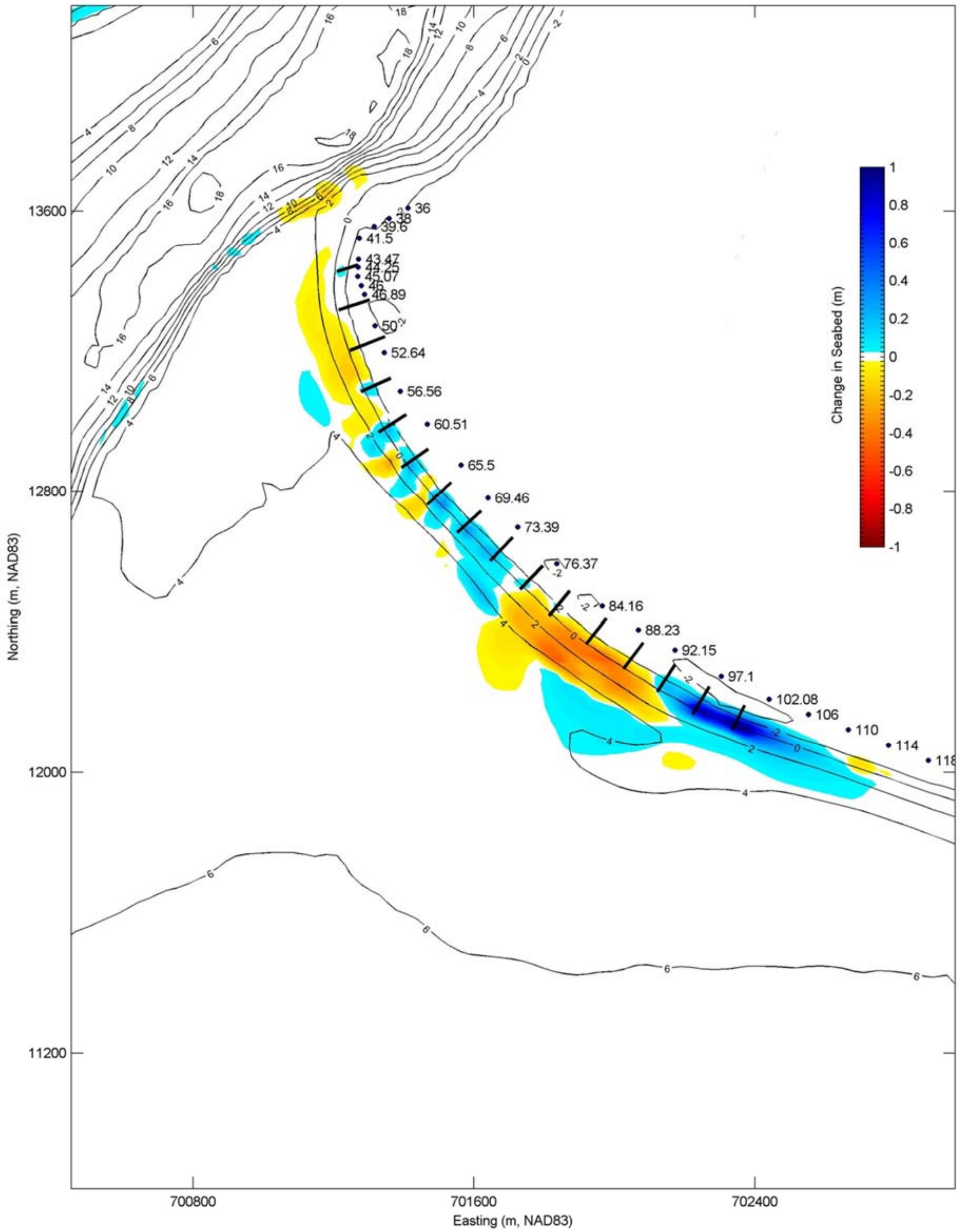

Figure 13: Predicted seabed differences attributable to the tube groins following a Bertha-like storm event following a 1.2Mcy fill -- computed as the difference between post-storm (final) bathymetries for with- and without-tube groin conditions. Yellow and red shading in the figure indicates areas where the seabed is lower due to the tube groins, while blue shading represents a raised seabed attributable to the tube groins.

Similar model simulations investigating the effects of inclusion and removal of the tube groins were completed for the with-terminal groin condition. **Figure 14** compares predicted erosion and sedimentation patterns under terminal groin with beach fill scenario both with and without the sand-filled tube groins. In the plots, yellow/red shading represents areas of erosion while blue shading represents sediment deposition resulting from the four-day storm. Overall, there are only minor differences in the predicted sediment transport pathways when the groins are not considered. Specifically, the presence of the tube groins appears to slightly slow sediment transport along western Bald Head Island. This is observable as moderate differences in color shading, particularly lesser shades of red/yellow east of the groin field and extending westward off the seaward end of the terminal groin; i.e., there is less predicted erosion/transport in these areas. Like the beach fill only example, these effects are expected to be stronger if the initial conditions did not represent a post-project beach in which the tube groins were mostly buried. The results suggest a net loss of approximately -58,450 cy from within the beach fill template without the tube groins. This represents a minimal increase in losses relative to the with tube groin condition where a net loss of about -55,350 cy was predicted within the same limits. Like the without terminal groin comparisons, the predicted decrease in sand losses with the tube groins in place is indicative of their net benefit, particularly considering they are not largely ‘active’ in this brief storm scenario.

Figure 15 plots the difference between the post-storm (final) bathymetries predicted with and without tube groins for the terminal groin and beach nourishment condition. Yellow and red shading in the figure indicates areas where the seabed is lower due to the tube groins, while blue shading represents a raised seabed attributable to the tube groins. Model results throughout the central and eastern portions of the groin field are similar to those discussed previously for the without terminal groin configuration. There are no significant changes in the post-storm seabed at the Point or on West Beach between the with- and without-tube groin scenarios.

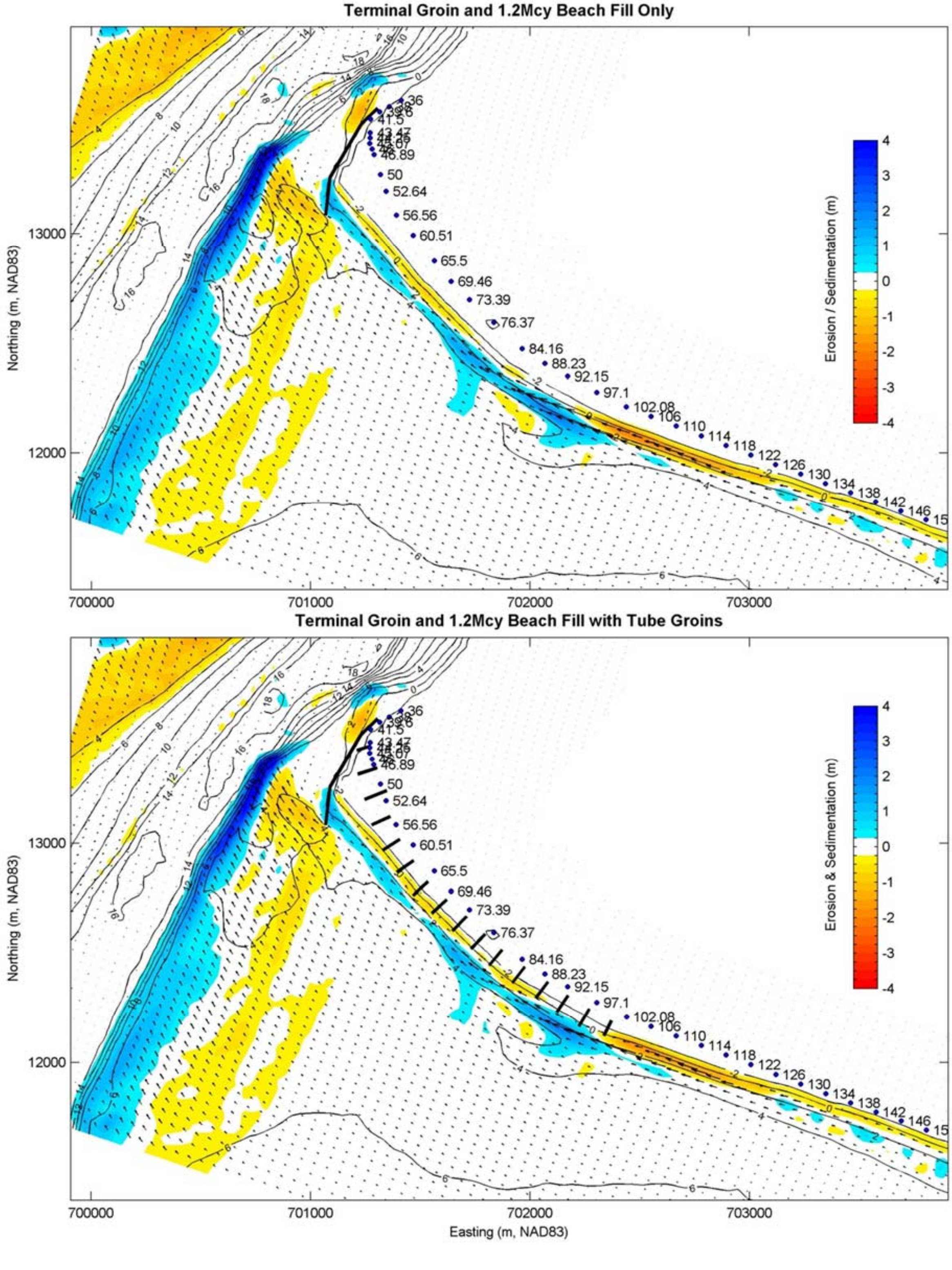

Figure 14: Comparison of predicted erosion/sedimentation patterns considering with and without the tube groins under the terminal groin with fill scenario.

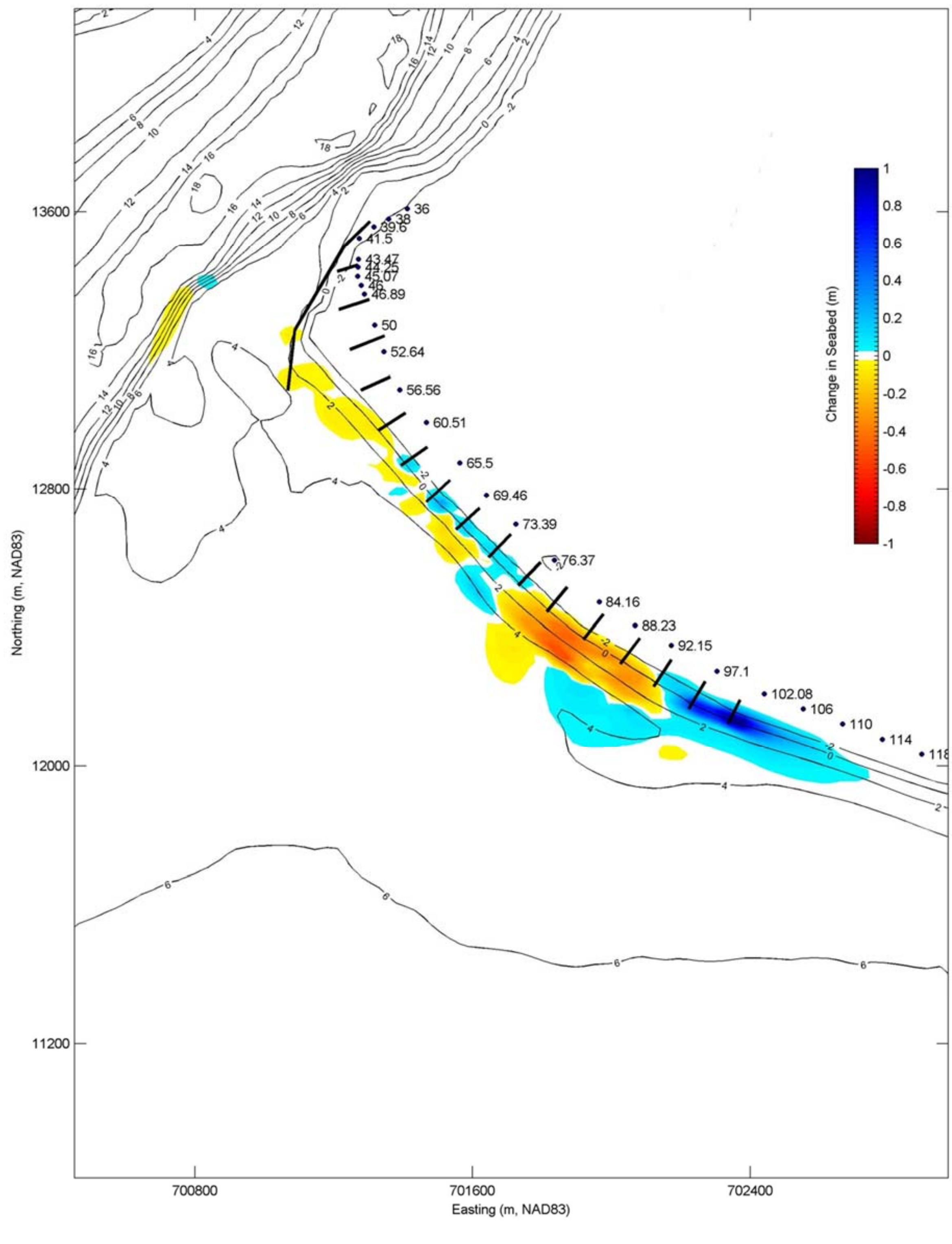

Figure 15: Predicted seabed differences attributable to the tube groins following a Bertha-like storm event following a 1.2Mcy fill with terminal groin -- computed as the difference between post-storm (final) bathymetries for with- and without-tube groin conditions. Yellow and red shading in the figure indicates areas where the seabed is lower due to the tube groins, while blue shading represents a raised seabed attributable to the tube groins.

In summary, the Delft3D model was used to simulate offshore storm conditions emanating from an event similar to the 1996 passage of Hurricane Bertha. The model results indicate that the terminal groin is capable of significantly reducing volume losses on South Beach while not meaningfully impacting the downdrift and West Beach shorelines, relative to a beach fill only condition. There is an indication of increased storm-related (seabed scour) erosion at the seaward tip of the terminal groin. Such scour is to be expected and will require attention in the detailed design phase to ensure long-term stability of the structure, typically through the use of a marine mattress foundation. Overall, the model predictions are generally consistent with those for typical annual conditions. The performance of the terminal groin and its beneficial effects upon both South Beach and neutral effects upon West Beach, relative to the without-terminal groin condition, are similar among both the severe storm and typical conditions. The presence of the sand-filled tube groins is predicted to have an overall positive (albeit limited) effect on the Island's ability to retain placed sediment when paired with the terminal groin. The limited nature of the tube groins' benefit in this simulation is principally due to the fact that the model simulates short-term morphological changes on a post-construction beach condition whereby the tube groins are largely buried in fill and do not significantly act upon the incident wave climate.

APPENDIX Q

CUMULATIVE EFFECTS ANALYSIS

Village of Bald Head Island Shoreline Protection Project
Cumulative Effects Analysis

Table of Contents

1.0 INTRODUCTION

The purpose of the cumulative effects analysis is to ensure that regulatory agencies consider the full range of consequences (i.e. cumulative effects) on specific resources, ecosystems, and human communities as a result of private, state, or federal projects reviewed under the provisions of the National Environmental Policy Act (NEPA). The Council on Environmental Quality's (CEQ) regulations for implementing NEPA defines cumulative effects as;

> "*the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such actions (40 CFR §1508.7)*".

The cumulative effects analysis is composed of three principle components with corresponding steps as outlined in Table 1.

2.0 SCOPING

2.1 Cumulative Effects Issues

Depending upon specific project location and design, beach disposal/nourishment projects and hardened structures have the potential to beneficially or adversely affect the following resources, ecosystems, and communities:

(1) shorebirds and waterbirds (including the federally-protected piping plover and its critical habitat);
(2) seabeach amaranth (Amaranthus pumilus);
(3) sea turtles;
(4) intertidal and subtidal soft bottom (including benthic assemblages)
(5) water column (including federally-managed species)
(6) water quality; and
(7) human communities.

Table 1. Steps in the Cumulative Effects Analysis (CEA) (as adapted from CEQ 1997)

Environmental Impact Assessment Components	CEA Steps
I. Scoping	a. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals b. Establish the geographic scope for the analysis c. Establish the time frame for the analysis d. Identify other actions affecting the resources, ecosystems, and human communities of concern
II. Describing the Affected Environment	a. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses b. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds c. Define a baseline condition for the resources, ecosystems, and human communities
III. Determining the Environmental Consequences	a. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities b. Determine the magnitude and significance of the cumulative effects c. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects d. Monitor the cumulative effects of the selected alternative and adapt management

These resources may be affected via the interactive or additive effects of a single project or of multiple projects occurring within an identified geographic and temporal scope. Examples of cumulative effects include time crowding (i.e. frequent and repetitive effects), space crowding (high abundance of stressors in a given spatial extent), or compounding effects. Each of the resources identified above will have different exposures and tolerance levels for actions associated with the type of project proposed.

Cumulative effects may arise from various stressors or impacts including: loss or disturbance to habitat; disturbance from mechanical operations of the dredge equipment and heavy machinery; indirect effects associated with short-term elevation of turbidity levels; expansion of supratidal beachfront; and structural impediments resulting from the installation of a terminal groin. These effects (and others) are evaluated in Section 5.0 of the DEIS.

2.2 Geographic and Temporal Scope

The cumulative effects analysis takes into consideration coincident effects (adverse or beneficial) of the proposed project as well as all related actions occurring within specified spatial and temporal boundaries. The project impact zone is the area potentially affected by the proposed action. Environmental resources of the river mouth, nearshore subtidal zone, and beachfront area may be affected by the VBHI Shoreline Protection Project. For the purpose of this cumulative impact assessment, the identified geographic region evaluated encompasses all beachfront and nearshore coastal areas of Onslow Bay and Long Bay. This constitutes 141 miles of shoreline.

This analysis considers known past, present, and reasonably foreseeable future (RFF) dredge and disposal/nourishment projects within the project vicinity over a thirty-five year period (1980 to 2015). The time period was selected to include the increase in the number of federal disposal projects in the early 1980s and was extended to 2015 because this date represents a reasonably foreseeable future. The majority of remaining beaches that could reasonably be expected to have federal projects implemented is included in this analysis.

3.0 ACTIONS AFFECTING RESOURCES

Cumulative effects analysis not only considers the impacts of past, present and RFF actions on the identified resources, but also the impacts from unrelated actions occurring in the vicinity of the project area including regional beach nourishment/beach disposal projects, hardened structures along the North Carolina coast, storms and sea-level rise.

Table 2 lists similar dredge and beach nourishment/disposal projects occurring within the geographic scope of this analysis and approximate distance from the proposed project. These projects are applicable for this evaluation given the type of activity and the potential for disturbance to identified resources. The cumulative direct and/or indirect effects of these projects have been evaluated in the context of each resource type. The compilation of projects represents those recent, current, and RFF projects that are either federally-funded or are sponsored via local initiatives.

3.1 Dredging & Beach Nourishment/Disposal

For the purpose of this assessment, intertidal and shallow subtidal shoal habitats have been mapped from available GIS data of tidal inlets and interpretation of aerial photography. Based upon this mapping effort, there are approximately 11,500 total acres of flood and ebb tide delta shoals (intertidal and shallow subtidal bottom habitat) extending from Barden Inlet (at Cape Lookout) to Little River Inlet. Expansive, undisturbed shoal habitat (as part of Frying Pan Shoals) also exists east of the project area. Frying Pan Shoals extend southeastward from Cape Fear approximately 20 miles into the Atlantic Ocean. Most maintenance dredging and navigation projects affect a relatively small percentage of the total intertidal and subtidal habitat occurring within a coastal inlet. Cumulatively, twelve (12) of the fifteen (15) active inlets within the assessment area have been recently, or are currently authorized to be, dredged for navigational improvements. Of these inlet areas, it is estimated that there are over

Table 2. Summary of Recent, Current, and RFF Projects (Onslow Bay and Long Bay) and Proximity to Bald Head Island Project Area

Project	Source of Sand for Nourishment	Beachfront Nourished	Approximate Volume of Material and/or Length of Shoreline	Approximate Dates of Occurrence	Distance to Bald Head Island Project Area
Section 933 Project (Outer Harbor)	Beaufort Inlet Outer Harbor	Indian Beach, Salter Path, and portions of Pine Knoll Shores	7 miles	Feb/March 2004 Jan-April 2007	75 miles north
Emerald Isle FEMA Project	USACE ODMDS – Morehead City Port Shipping Channel	Emerald Isle	3.8 miles	Mar-04	75 miles north
Emerald Isle Post-Isabel, Ophelia, and Irene Projects (FEMA)	ODMDS	Eastern Emerald Isle, Indian Beach, Pine Knoll Shores	156,000 cy; 1.23 Mcy; 992,000 cy	2004, 2007, 2012	75 miles north
Bogue Banks FEMA Project	USACE ODMDS – Morehead City Port Shipping Channel	Emerald Isle (2 segments), Indian Beach, Salter Path, Pine Knoll Shores	13 miles (cumulatively)	Jan/Feb 2007	75 miles north
USACE Dredge Disposal to Eastern Bogue Banks (Federal)	Beaufort Inlet Inner Harbor and Brandt Island Pumpout	Fort Macon and Atlantic Beach	Varies (180,000 cy to 4.67 Mcy)	1978, 1986, 1994, 2002, 2005, 2007	75 miles north
Bogue Banks Shore Protection Project (Federal)	Offshore Borrow Sites	Communities of Bogue Banks	24 miles	2009-2011	75 miles north
Bogue Banks Restoration Project – Phase I – PKS/IB Joint Restoration	Offshore Borrow Areas	Pine Knoll Shores and Indian Beach	7.4 miles	Winter 2001/2002	75 miles north
Bogue Banks Restoration Project – Phase II – Eastern EI	Offshore Borrow Areas	Indian Beach and Emerald Isle	5.9 miles	Winter 2002/2003	75 miles north
Bogue Banks Restoration Project – Phase III– Bogue Inlet Channel Realignment Project	Bogue Inlet Channel	Western Emerald Isle	4.5 miles	March-05	72 miles north
AIWW Section 1 – Tangent B (Federal)	AIWW shoaling directly north of Pine Knoll Shores	Eastern limit of Pine Knoll Shores	2,000 lf	Jan-March 2008	75 miles north
Inlet Crossing at Bogue Inlet (Federal)	Bogue Inlet – ocean bar to AIWW via connecting channel	Western Emerald Isle	0.66 miles (38,000 cy per event)	Summer 2006 (anticipated frequency 1 to 3 years)	70 miles north
North Topsail Beach Nourishment (Federal)	New River Inlet Dredging	Surf City and North Topsail	11.1 miles	Maintenance dredging every four years	52 miles north
North Topsail Dune Restoration (Town of North Topsail Beach)	Upland borrow source near Town of Wallace, NC	North Topsail Beach	47,300 cy	2006	52 miles north
North Topsail Beach Shoreline Protection Project	New River Inlet Realignment and Offshore Borrow Area	Topsail Island	5 phases totaling 11 miles	Phase 1-5 occurring every other year 2009-2017 (subject to regulatory approval)	52 miles north
Topsail Island Beach Nourishment (Federal)	New Topsail Inlet	Topsail Island	Varies	Maintenance dredging	40 miles north
Figure Eight Island	Banks Channel and Nixon Channel	North & South Sections	2.5 miles	Winter 2005/2006	35 miles north
Figure Eight Island - Terminal Groin and Beach Nourishment		Figure Eight Island		TBD	35 miles north
Mason Inlet Relocation Project	Mason Inlet (new channel) and Mason Creek	North end of Wrightsville Beach and south end of Figure Eight Island	1.9 miles	Jan-March 2002 (smaller maintenance events of inlet throat, sedimentation basin, and AIWW on as needed basis)	30 miles north
Wrightsville Beach (Federal)	Masonboro Inlet	Wrightsville Beach	2.84 miles	4-year cycle: Winter 2004/2005 Proposed 2013/2014	25 miles north
Carolina Beach (Federal)	Carolina Beach Inlet	Carolina Beach	2.0 miles	3-year cycle: Dec 2006 – Feb 2007; winter 2012/2013	15 miles north
Kure Beach (Federal)	Wilmington Harbor CDF Area 4	Kure Beach	2.0 miles	3-year cycle: Dec 2006 - Feb 2007; February 2013	10 miles north
Wilmington Harbor Deepening (933 Project) Sand Management Plan	Wilmington Harbor Ocean Entrance Channels	Bald Head Island, Caswell Beach, Oak Island	Varies (2 to 4 miles)	6-year cycle: Winter 2001/2002; 2005/2007; 2012/2013	0 miles to 10 miles west
Brunswick County Beaches Project	Nearshore and Offshore Borrow Areas	Caswell Beach, Yaupon Beach, Long Beach, Holden Beach	30 miles +/-	Notice of Intent to Prepare EIS issued May 2012	0 miles to 20 miles west
Oak Island Section 1135 - Sea Turtle Haibtat Restoration	Upland Borrow Area - Yellow Banks	Oak Island	2 miles	Winter/Spring 2001	5 to 10 miles west
Bald Head Island Creek Project (non-federal)	Bald Head Creek	South Beach	1,800 lf	Winter 2006	0 miles
Bald Head Island Beach Nourishment	Jay Bird Shoals	West and South Beach	4 miles	Winter 2009/2010	0 miles
Bald Head Island Creek Project (non-federal)	Bald Head Creek	Western South Beach	140,000 cy	March 2012	0 miles
Bald Head Island Shoreline Protection Project	Wilmington Harbor Ocean Entrance Channels	West and South Beach	0.25 Mcy	TBD; anticipated winter 2015	0 miles
Holden Beach (933 Project)	Wilmington Harbor Ocean Entrance Channels	Holden Beach	1.9 miles	March-April 2002	16 miles west
Holden Beach East & West (sponsored by Town)	Upland truck hauling	Extension of 933 Project	160,000 cy	March-April 2002	16 miles west
Holden Beach East & West	Upland truck hauling	Extension of 933 Project	200,000 cy	December-03	16 miles west
Holden Beach - Terminal Groin and Beach Nourishment	TBD	Holden Beach within vicinity of Lockwood Folly Inlet	TBD	TBD	16 miles west
Holden Beach – AIWW 400-ft Widener (GP 2878)	AIWW at Lockwood Folly Inlet Crossing	East end of Holden Beach	100,000 cy	Winter 2014	16 miles west
Lockwood Folly Inlet Crossing (Federal)	Inlet crossing of AIWW	Long Beach and East end of Holden Beach	80,000 to 165,000 cy each event	November 2001 - April 2006	10 to 20 miles west
Shallotte Inlet (Federal)	Inlet crossing of AIWW	Ocean Isle Beach	5.3 miles in '01 48,000 cy in 06	Winter 2001 and 2006	26 miles west
Ocean Isle - Terminal Groin and Beach Nourishment	TBD	OIB within vicinity of Shallotte Inlet	TBD	TBD	26 miles west

9,000 acres of ebb tide and flood tide shoals. Most inlet navigational projects affect a relatively small percentage of the total shoal habitat associated with an inlet. Considering that these areas are actively changing due to natural physical processes, the alteration from dredging is considered a temporal disturbance.

For the VBHI Shoreline Protection Project, it is the applicant's proposal that sand for the required groin fillet (estimated at 0.25 Mcy of material) would be principally derived from the next maintenance event of the Wilmington Harbor federal navigation project. Additional sand source sites identified by the applicant to augment the fillet or for maintenance and future Village-sponsored nourishment are: (1) Jay Bird Shoals; (2) reaches of the Wilmington Harbor Channel demonstrated to contain beach-compatible material (i.e. Baldhead Shoal Channel 1, Baldhead Shoal Channel 2, and Smith Island Channel); (3) Bald Head Creek Shoal; and (4) Frying Pan Shoals.

Within the geographic scope of this analysis (141 miles of shoreline), there are ten (10) authorized and/or active inlet projects (federal and non-federal actions) and eleven (11) nourishment projects affecting approximately 50 miles of beachfront. Thus recent, current, and/or authorized beach nourishment projects affect approximately 35% of the total length of shoreline of Onslow Bay and Long Bay. On a broader geographic scale, North Carolina has 320 miles of shoreline. According to a recent cumulative impact assessment prepared by the USACE for the Bogue Banks Coastal Storm Damage Reduction Project (USACE 2013), existing or proposed federal projects total approximately 122 miles of beach or 38% of North Carolina beaches. Considering all existing and proposed federal and non-federal nourishment projects, and taking into consideration that some of the project footprints overlap, approximately 112 miles or 35% of the North Carolina coast could have beach nourishment or sand disposal projects by 2015.

The VBHI Shoreline Protection Project may affect up to 13,000 total linear feet of beachfront (South Beach and West Beach, combined). This represents approximately 0.8% of the 320 miles of beachfront in North Carolina and 1.7% of beachfront in the assessment area of Long Bay and Onslow Bay. There are approximately 8.5 miles of remaining undisturbed beach along eastern South Beach and East Beach of Bald Head Island. Therefore, the potential extent of nourished beach for this project represents approximately 22% of the beachfront on Bald Head Island.

Frequency of nourishment events can vary dramatically pending a number of project-specific factors including funding, need (i.e. sediment losses), and the identified source of beach-compatible sand. Some level of maintenance is typically authorized over the life-span of a permit (often 30-year or 50-year periods). The proposed schedule for nourishment and/or maintenance events is commonly affected due to physical responses in the project area and funding issues. In addition, nourishment projects of a single beachfront may be the result of multiple initiatives through federal, municipal, or private entities. Therefore, determining specific interval frequencies is difficult. However, a review of available documents indicates that nourishment projects may range from one-time events to more frequent intervals of 2 to 4 years. In general, the frequency of occurrence has been such that biological recovery is likely over most stretches of shoreline. Cumulative effects (positive or negative) are discussed for each identified resource in Section 6.0 of this document.

3.1.1 Dredging and Disposal Actions associated with the Wilmington Harbor Project (Past, Present, and RFF)

In addition to spatial considerations, repeating actions may present additive effects of disturbance to affected resources. The Cape Fear River ocean bar channel has been maintained by the federal government for over 100 years. Over this time period, the width and depth of the navigational channel has been increased several times to accommodate larger vessels. By 1945, the federal channel had been deepened to 32 feet. In 1964, the US Army Corps of Engineers (USACE) initiated deepening of the main harbor channel to 38 feet to accommodate 34-foot-draft (26,000 deadweight ton) vessels to call at any tide. This project was completed in 1970. Since the 1970s, vessel sizes increased significantly. By the 1990s, approximately 50% of the ocean-going ships exceeded the 26,000 deadweight ton (DWT) design vessel. As such, these vessels could enter or leave Wilmington Harbor only at high tide or only when light-loaded (USACE 1996). The resultant increased shipping costs prompted the more recent Wilmington Harbor Deepening Project in 2001. The channel modifications included realignment of the ocean bar channel (30-degree southern shift); deepening of the ocean bar channel and entrance channel to 44 feet; and deepening of the 24.3-mile river reach (from Battery Island Channel to the Cape Fear Memorial Bridge) to 42 feet (USACE 2008).

Prior to channel entrance modifications in 2001, maintenance of the entrance channel required annual removal of between 500,000 and 1,000,000 cubic yards of material. Much of the material removed was placed in the Wilmington Ocean Dredge Material Disposal Site (ODMDS) located three (3) nautical miles offshore. The ODMDS was the primary disposal site for material dredged from three principal zones of the river: (1) ocean bar channels; (2) the navigation channel to Wilmington (excluding the ocean bar and reaches above the Lower Brunswick channel); and (3) Military Ocean Terminal at Sunny Point (MOTSU). Between 1976 and 2004, approximately 49 Mcy of material were placed in the Wilmington Harbor ODMDS. In 2000, the Sand Management Plan (SMP) for disposal of material derived from maintenance of the ocean entrance channels and other portions of the harbor was implemented. One of the goals of the SMP is to return beach-quality dredged material to the active littoral system when feasible. A new offshore ODMDS is still utilized for placement of non-compatible material high in silt and clay content or material consisting of woody debris. The Wilmington Harbor Dredge Material Management Plan (DMMP) provides more specific information related to dredge quantities and subsequent placement within the former and current ODMDS sites.

The Wilmington Harbor project, historically, did not provide for the placement of littoral sands on barrier island beachfronts due in large part to dredging technology and the lack of understanding for coastal processes (particularly with respect to the sand sharing system associated with tidal inlets and adjacent beaches) (USACE 2000). Over time, it has become well recognized that littoral material should be conserved (when practicable and economically feasible) via deposition directly on adjacent beaches or appropriate nearshore placement areas. As a result, the Wilmington Harbor SMP was developed and implemented as part of the larger Wilmington Harbor deepening project in 2000. Subsequent to the development of this plan, approximately 4.8 Mcy of ocean-derived sediments were dredged as part of the new alignment of the ocean entrance channel (USACE 2004). The beach-quality dredged material was distributed on Bald Head Island, East Oak Island-Caswell Beach, West Oak Island, and Holden Beach. Shoaling of the new entrance channel results, in part, from the combined effect of the eastward movement of Jay Bird Shoals; erosion from western South Beach; and the westward movement of Bald Head Shoal into the channel gorge. Based upon sediment transport analyses conducted by the USACE, approximately 66% of the sediment shoaling the channel is derived from the Bald Head Island side of the channel while 34% is derived from the Caswell Beach side (USACE 2000). In order to redistribute this material, sand is currently disposed on the shoreline of Bald Head Island in Year 2 and Year 4 of each six-year disposal cycle and on Oak Island-Caswell Beach during the sixth year of the cycle subject to availability of funding and dependent upon navigation priorities.

The USACE has identified Frying Pan Shoal as the sand source for the Brunswick County Beaches (BCB) Coastal Storm Damage Reduction Project. The USACE is in the process of preparing an Integrated General Reevaluation Report (GRR) and Draft Environmental Impact Statement (DEIS) for the project in accordance with Corps' Planning Guidance and NEPA. Actual implementation of the Federal BCB project (if implemented at all) is likely to be at a much later date than the VBHI Shoreline Protection Project. As such, time crowding of actions and associated additive impacts would become less of an issue. Given the size of the shoal feature relative to any prospective borrow sites, spatial crowding effects are likewise to be minimal. As a result, cumulative impacts potentially affecting this resource are not anticipated.

3.1.2 Dredging and Nourishment Actions specific to Bald Head Island (Past, Present, and RFF)

Sand placement activities constructed at Bald Head Island since 1991 are summarized in Table 3. The three small scale disposal projects constructed between 1991 and 1997 were cost-shared or paid for by the Village of Bald Head Island. The 2001 disposal operation was constructed as an element of the Wilmington Harbor Deepening Project. The disposal sand was placed as a designed berm along 15,500 ft of shoreline on South Beach. In Year 2 of the SMP cycle, approximately 1.2 Mcy was placed on South Beach between November 3004 and January 2005. A small scale non-federal West Beach sand disposal project was constructed by the Village in 2006 as a by-product of the dredging to the entrance of Bald Head Creek. In response to erosion of the western end of South Beach, the Village designed and implemented a larger beach restoration project that resulted in the placement of 1.85 Mcy of beach sand during the 2009/2010 dredge and nourishment window. The sand source site for this project was approximately 158 acres of the distal, subtidal portions of Jay Bird Shoals.

Sand losses subsequent to the 1.85 Mcy project in 2010 prompted the Village to identify and permit the use of an approximate 21-acre sand source site at the mouth of Bald Head Creek. The purpose of the project was to provide supplemental sand to an eroded segment of western South Beach. In March 2012, the Village completed the dredge and placement of 140,000 cy. Most recently (during the Winter and early Spring of 2013), the maintenance dredging of the Federal channel has resulted in the disposal of approximately 1.8 Mcy along South Beach and a portion of West Beach.

Table 3: Beach disposal activities at Bald Head Island since 1991.

Year	Volume
1991	0.35 Mcy
1996	0.70± Mcy
1997	0.45 Mcy
2001	1.849± Mcy
2005	1.217 Mcy
2006	47,800 cy
2007	0.9785 Mcy
2010	1.85 Mcy
2012	102,000 cy
2013	1.8 Mcy

3.2 Hardened Structures

3.2.1 Hard Stabilization Actions in the State of North Carolina)(Past, Present, and RFF)

Until recently, it has been the State's policy to limit the use of hardened erosion control structures on oceanfront shorelines. Seawalls and similar structures were banned by the Coastal Resources Commission in 1985. In 2003, the CRC's prohibition of hardened structures was placed into law with House Bill 1028 which amended the NC Coastal Area Management Act (CAMA). The few engineered structures existing in the State are largely limited to structures which protect important transportation corridors, existing commercial navigation channels of regional importance, and locations of historical significance. Existing hardened structure include the following (NCCRC 2010);

- jetty and weir jetty - Masonboro Inlet
- rock revetment - Carolina Beach
- rock revetment – near Fort Fisher
- groins – Cape Hatteras Lighthouse and Coast Guard Station
- terminal groin – Pea Island and Oregon Inlet
- terminal groin – Fort Macon (Beaufort Inlet)

In June 2011, the General Assembly of North Carolina ratified Senate Bill 110 *("An Act To Authorize The Permitting And Construction Of Up To Four Terminal Groins at Inlets Under Certain Conditions*"). The legislation included various requirements that must be met prior to issuance of a CAMA Major Permit for a terminal groin. In July 2013, SB 151 ("*An Act to Amend Marine Fisheries Laws; Amend the Laws Governing the Construction of Terminal Groins, and Clarify that Cities May Enforce Ordinances within the State's Public Trust Areas*") was ratified by the NC General Assembly and subsequently approved as law in August 2013 (Session Law 2013-384). SB 151 reduced some of the requirements placed upon applicants seeking authorization to construct terminal groins. The specific provisions of SB 151 are discussed in the DEIS. Currently, four proposed terminal groin projects (Figure Eight Island, Bald Head Island, Holden Beach, and Ocean Isle Beach) are under review for authorization in North Carolina. Under the existing law, this is the maximum number of terminal groins that can be authorized in North Carolina.

3.2.2 Hardened Structures specific to Bald Head Island (Past, Present, and RFF)

A. Sand Tube Groinfield

Presently, the 5,300 ft westernmost segment of South Beach of Bald Head Island is quasi-stabilized by a sixteen (16) structure sand tube groinfield originally constructed in 1995 and subsequently replaced in its entirety in both 2005 and 2010. With the last two reconstruction programs, minor design changes to groin location, groin length, and (most importantly) geotextile materials comprising the individual tube structures have occurred in accordance with the original design precepts. The sand tube groinfield was authorized by CAMA Major Permit No. 9-95 (USACE Action ID No. SAW-1994-04687).

The current location, individual lengths and spacing of the sixteen (16) sand tube groins is depicted by Figure 1.3 of the DEIS. The structures currently exist along South Beach between survey baseline Station 47+50 (on the west) and Station 100+00 (on the east). The groin tubes vary in length from 250 ft. to 350 ft. Each geotube is tapered and varies in height from 5.7 ft to approximately 4.0 ft at its seaward tip. For purposes of installation, the beach is excavated to elevation +2 ft. NGVD. Each tube is then filled within the excavated beach (*i.e.* in a trench) which is subsequently backfilled. During each beach fill operation, the groins are essentially buried (*i.e.* overfilled) by design and therefore remain inactive until the fill berm equilibrates to the point that the tubes are exposed to wave energy. Their effectiveness in reducing littoral transport and maintaining a protective beach berm within each groin cell (located between any two groins) varies over time depending on their level of interaction with waves.

B. Sand Bag Revetment

In July 2011, the North Carolina Division of Coastal Management (NCDCM) and the U.S. Army Corps of Engineers (USACE) granted a minor modification of existing CAMA Permit No. 9-95 and USACE Action ID SAW-1994-04687, respectively, thereby authorizing the construction of a 350 lf sandbag revetment beginning at sand tube groin No. 16 and extending in a general northwesterly alignment. The purpose of the temporary structure was to address chronic inlet-related beach and dune erosion and recession occurring westward of the last sand tube groin. Subsequently, in 2012 a second minor permit modification was issued to the Village which allowed for the placement of up to 1,200 cy of sand to be placed on top of the sand bag revetment. The source of the sand was the 2009-2010 Village beach fill project berm located to the east of the revetment. The selection of borrow areas was based upon existing dry beach width. All of the area subject to temporary borrowing was subsequently filled as a result of a large scale (1.8 Mcy) federal navigation maintenance project with beach disposal undertaken in the spring of 2013.

3.3 Storms

Major storms, such as hurricanes and northeasters, have been acknowledged as significant events that can affect the form of barrier islands. Storm tides associated with oceanic storm surges are extremely important to shoreline dynamics. Damage from wind, salt toxicity, and overwash, combined with shore retreat, can severely impact the biological integrity of the island. Hurricanes making landfall in the project area as well as winter storms with sustained northeasterly winds have been shown to exacerbate shoreline erosion and resultant biological impacts on the island. The NOAA National Weather Service maintains a database of hurricanes impacting the Atlantic Coast. Table 4 provides a summary of hurricanes which have impacted Bald Head Island since 1996.

3.4 Sea-level Rise

According to the NC Coastal Resource Commission Science Panel on Coastal Hazards, historical tide gauge data and geologic evidence obtained over the last several centuries provide evidence that sea level is steadily rising in the state of North Carolina. Additionally, data collected from scientific studies within the state suggest that relative sea level (RSL) change varies as a function of latitude along the North Carolina coast. RSL change is higher in the northern part of the state with lower documented rates in the south and varies from 2.04 mm/yr to 4.27 mm/yr (NCCRC 2010b).

NOAA maintains a detailed record of sea level trends at stations around the United States. The nearest such station to the study area is at Southport, immediately inside Cape Fear Inlet (Station 8659084). The measured data at Southport cover the period between 1933 and 2006 and suggest that the local water level rises approximately 2.08 mm/year, or about 0.21 meters (0.69 feet) per 100 years, on average.

Table 4: Hurricanes impacting Bald Head Island since 1996.

Hurricane	Year
Irene	2011
Hanna	2008
Ophelia	2005
Charley	2004
Irene	1999
Floyd	1999
Bonnie	1998
Fran	1996
Bertha	1996

Riggs and Ames (2003) predicted increased rates of sea-level rise will adversely impact the North Carolina coast in the following ways: accelerated rates of coastal erosion and land loss; increased economic losses due to flooding and storm damage; increased loss of urban infrastructure; collapse of some barrier island segments; and increased loss of estuarine wetlands and other coastal habitats. Sea-level rise has the potential to increase the volume of sand required for beach nourishment projects region-wide.

4.0 RESOURCE CAPACITY TO WITHSTAND STRESS AND REGULATORY THRESHOLDS

In 1972, Congress passed the Coastal Zone Management Act, which encouraged states to keep the coasts healthy by establishing programs to manage, protect, and promote the country's fragile coastal resources. Two years later, the North Carolina General

Assembly passed the landmark Coastal Area Management Act (CAMA). CAMA established the Coastal Resources Commission, required local land use planning in 20 coastal counties, and provided for a program for regulating development. The North Carolina Coastal Management Program was federally approved in 1978 by NOAA.

Demands placed on lands and waters of the coastal zone from economic development and population growth require that new projects or actions be carefully planned in order to avoid stress on the coastal zone. This planning involves a review of state enforceable policies, which are designed to provide effective protection and use of land and water resources of the coastal zone. Under CAMA, the proposed work cannot cause significant damage to one or more of the historic, cultural, scientific, environmental or scenic values or natural systems identified in Areas of Environmental Concern (AECs). In addition, significant cumulative effects cannot result from a development project.

5.0 RESOURCE BASELINE CONDITIONS

The resources potentially affected by past, present, and RFF dredging; beach nourishment and sand disposal activities; and terminal groin construction are listed above in Section 2.0 above. Baseline conditions such as status of populations, life histories, stressors (both natural and anthropogenic), and ability to adapt to stressors for each of these resources are described in corresponding sections of the project DEIS (Section 4.0 and 5.0), the Essential Fish Habitat (EFH) report, and the project Biological Assessment (BA). Information pertaining to human communities in the context of the cumulative effects issues is provided below.

Development pressures along the coast of North Carolina have significantly increased over the years with the influx of people wanting to live near the water. The State's position regarding beach ownership is that the public has always enjoyed the right to use the dry sand beach located above the normal high water line until the growth of vegetation or dune line occurs. The preservation of a stable beachfront is a critical aspect of the State's tourist industry.

Development of Bald Head Island began in 1972 with the construction of an inn and 18-hole golf course. The developer, Bald Head Island Limited, designed the phased plan development of the Island which encompasses 2,000 acres. With increasing build-out and anticipated increase of both permanent and part-time residents, along with the inherent advantages of municipal form of government for achieving the planned community goals, the Village of Bald Head Island was incorporated as a municipality in 1988.

The island is accessible to the public by means of a passenger ferry which operates between Southport, NC and Bald Head Island Marina. The Village exists primarily as a second home community and is a well-known tourist and seasonal destination. Commercial activity is primarily limited to retail trade including: grocery, hardware and restaurants. Other than retail trade, the only other non-residential construction activity involves the marina, country club, multifamily common areas, Bald Head Island Conservancy, office space, and town-owned facilities.

While there is a relatively small population of permanent, year-round residents (approximately 220), Bald Head Island serves the public (including residents of North Carolina and visitors from others state and countries), with its beachfront being among its principal draws. There are on average 5,000 visitors to the Island during a typical summer weekend day. Water-related activities along Bald Head Island include, boating, diving, sailing, windsurfing, surfing, kite surfing, stand-up paddle boarding and canoeing. Numerous beach accesses are maintained to support the daily public demands. The Bald Head Island Conservancy offers organized hikes, nature walks and kayak tours to permanent residents, guests and the general public. An eighteen-hole golf course is also available at the Bald Head Island Club. The golf course is open to member guests and is available with rental properties that have memberships.

The project area, located at the confluence of the Cape Fear River and Atlantic Ocean, is public and provides unique and important public beach resources and access, as do all of Bald Head Island's beaches. Maintenance of the beachfront for recreational use is a critical component of the Island tourism. The beachfront has been nourished via federal sand disposal and Village-sponsored projects over the last decade. The net beneficial effect of these soft stabilization measures for the Bald Head Island community has been the protection of properties and infrastructure as well as the use of a more expansive and stable beachfront.

6.0 DETERMINATION OF MAGNITUDE AND SIGNIFICANCE OF CUMULATIVE EFFECTS

The following is a qualitative assessment of the potentially beneficial, adverse, or neutral cumulative effects of the proposed action and similar past, present, or reasonably foreseeable future actions on identified resources.

6.1 Shorebirds and Waterbirds

The federally-protected piping plover and a variety of other shorebirds and colonial waterbirds are known to forage within the surf zone along Bald Head Island throughout the year. Moving sand to nourish or dispose of on the shoreline as well as short-term beach stabilization methods may bury intertidal macrofauna and reduce the available food resource to birds in this area. In general, beachfront fill placement results in short-term declines in species abundance, biomass, and taxa richness. Studies have shown that intertidal macrofauna can recolonize a nourished area within one or two seasons (Ross and Lancaster, 1996; National Research Council, 1995; Van Dolah et al. 1984; Reilly and Bellis, 1978). Directly after impacts to macrofauna have occurred and numbers of these species are depressed, birds that prey upon these invertebrates, including plovers, would likely move to adjacent undisturbed beach areas or tidal flats for the temporary period of population re-establishment.

While there will be a direct loss of prey species (i.e. crabs and worms) for birds following placement of the dredged sand, additional foraging impacts could result if the disposal material does not closely match the recipient beach. Sediment that is too coarse and/or contains high shell content can inhibit a bird's ability to extract food particles from the sand (ASMFC 2002). Material from the entrance channel reaches have been demonstrated to be compatible as evidenced through several federal disposal events. Likewise, in the event the VBHI utilizes one of the four prospective sand source sites, all beach fill material would comply with the State of North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). As a result, risk of these latter effects is considered to be minimal.

Dredge operations and sand placement projects are generally confined to the period of the year between November 15th and April 1st thereby avoiding the larval recruitment period of coquina clams (spring and summer) and mole crabs (early October) (Donoghue, 1999). As such, cumulative effects are manifested more likely from a spatial crowding of disturbance rather than temporal effects. If significant expanses of intertidal shoal and mudflat habitat are being excavated along a stretch of shoreline, then shorebirds and waterbirds are not only impacted by diminished food resources but by loss of habitat utilization as well. Shorebirds and waterbirds will preferentially seek suitable areas for foraging and roosting readily available outside of the project area.

Nourishment and associated construction activities within the intertidal surf zone could influence foraging and resting winter residents and spring migrants. For the Mason Inlet Relocation Project (which involved the backfilling of a small tidal inlet and its relocation 3,000 ft north), piping plover spring migrants were documented to pass over the Mason

Inlet shoals during construction (2002) and instead favor Rich Inlet to the north for foraging and resting. Likewise, fall migrants avoided Mason Inlet later in the year, stopping again at Rich Inlet before continuing southward of the study area. Since that time, expansive mud flats have developed on the backside of the relocated inlet. These areas have become a favored foraging and resting site for both wintering and migrant piping plovers (Webster 2006).

The terminal groin as currently proposed by the Village of Bald Head Island would be porous and would thus allow for sediment passage both through and over the structure. Inlet-directed sediment losses (i.e. shoaling of the adjacent federal channel) would continue to occur. In addition, the Point is expected to continue to migrate north as has been documented over the last several years. While sediment transport rates will be reduced, the Point feature will continue to exist. As a result, the intertidal and supratidal areas associated with this feature should continue to provide foraging, resting, and nesting habitat for shorebirds and colonial waterbirds. As has been observed on the south end of Wrightsville Beach, the presence of a low-profile structure does not prohibit sand accretion to downdrift areas. Indeed, the expanding spit in this particular area has recently become a viable nesting site for least terns and American oystercatchers.

Other regional projects have incorporated mitigative measures that have resulted in a net benefit to shorebird and waterbird populations. The Mason Inlet project included creation of the Mason Inlet Waterbird Management Area that serves as a sanctuary for nesting birds. Audubon North Carolina (in cooperation with New Hanover County and the Town of Wrightsville Beach) has assumed the responsibility of monitoring and maintaining this area. In addition, Audubon offers conservation and educational programs for the public. Audubon has documented nesting species to include least terns, black skimmers, common terns, and Wilson's plovers within the Inlet Management Area.

Previous federal projects associated with maintenance of Wilmington Harbor have also resulted in the creation of colonial waterbird nesting islands within the Cape Fear River. These islands have been documented successful nesting sites for gulls, terns, and waders in the estuary (Parnell et al. 1997). The islands are suitable locations because they tend to be relatively stable, extend well above the high-tide line, and support appropriate vegetation. Additionally, many of these islands are surrounded by open water and are relatively inaccessible to mammalian predators.

Additional cumulative effects may manifest from increased human disturbance via habitat encroachment. Continued beach nourishment projects could favor the increase of humans along the beachfront. However, beaches of developed barrier islands already have an established human presence. Shorebird and waterbird populations have already been subject to this type of disturbance to some degree. While potentially detrimental, human encroachment and disturbance is not expected to be incrementally worse with multiple projects. Additionally, with awareness and educational programs through the Bald Head Island Conservancy, any potential adverse effects of human activity along the BHI beachfront can be mitigated.

The southern and western-facing beaches of Bald Head Island have been the site of periodic nourishment and sand disposal in the past either through federal navigation disposal or Village-sponsored projects. Since 1991, there have been 10 sand placement events of varying size, which equates to one event every 2.3 years. Several of these projects have been small in scale and affected only a small section of the shoreline. Other projects have been much larger. However, all of the projects left an unaffected adjacent beachfront (specifically East Beach) and birds are presumably able to move to these areas to forage during and immediately after construction. Furthermore, benthic infaunal species have been demonstrated to re-populate nourished beaches over a relatively short period of time.

The site of the proposed terminal groin is an area characterized by chronic erosion and instability. In the absence of nourishment, the beach profile tends to slope steeply from upland dunes to wet beach. As a result, the existing condition provides little opportunity for suitable bird nesting habitat. The installation of the groin coupled with periodic nourishment would promote a more stable dry beach with the potential for increased nesting. However, more stable conditions can also favor the growth of upper beach or dune vegetation. Denser vegetation would provide increased cover for predators and would also restrict nesting of certain species including the American oystercatcher and the Wilson's plover.

As stated above, the BHI project would affect approximately 1.7% of the total length of shoreline of Onslow Bay and Long Bay. All recent, current, and/or authorized beach nourishment projects combined affect approximately 35% of the shoreline. When considering all of these projects, a large portion of the assessment area will have beach placement activities in the foreseeable future, which could affect benthic infauna populations. However, given funding constraints of these projects and the limited availability of dredging equipment, it is improbable that all or even most of these proposed projects would be constructed at once. Further, most of these projects will leave adjacent unaffected portions of beach that will be available habitat for food resources of shorebirds and waterbirds during and immediately following construction. Thus, cumulative effects from projects in the assessment area are considered neutral.

6.2 Seabeach Amaranth

Seabeach amaranth is an annual herb that occurs on beaches, lower foredunes, and overwash flats (Fussell, 1996). Historically, seabeach amaranth was found from Massachusetts to South Carolina. The species is currently found in New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina. The decline of this species is a result of beach stabilization efforts, storm-related erosion, and human recreational use of its habitat (USFWS, 1996). Weakley (1986) found that in North Carolina the plant is most common on overwash flats on accreting ends of barrier islands. This species occupies elevations ranging from 0.2 to 1.5 m above mean high tide (Weakley and Bucher, 1992). Since dredging of the borrow area will be performed within open waters of the Cape Fear River or nearshore waters of the Atlantic Ocean in the event that the federal navigation channel is unavailable at the time of project implementation, no impacts to amaranth plants will occur from this action. Project-related beach nourishment would take place no earlier than November 16th, when amaranth plants have already released seeds. Deeply burying existing seeds via nourishment could negatively affect the amaranth population in later seasons. Assuming that seeds are located in the general position of former parent plants observed in past surveys, sediment placed on the beach may bury seeds and delay germination the following year.

Groin construction would extend into the summer months. Construction actions (including the excavation and reworking of recently nourished sand) could have an effect on amaranth germination. However, the site of the proposed groin is within a chronically and severely eroded condition that is not well-suited for the occurrence of seabeach amaranth. Studies have found that groins have mixed effects on seabeach amaranth (USFWS, 1996). Immediately updrift from a groin, accretion sometimes provides or maintains habitat suitable for seabeach amaranth. Immediately downdrift of a groin, seabeach amaranth habitat may become degraded if the area is sediment-starved. However, in 1991 Long Island's (New York) largest population occurred along a groin field. Furthermore, the porous design will allow for sand passage through and over the proposed structure to minimize any potential downdrift impacts to the upper beach. It should be noted that updrift stabilization of the dry beach could potentially expand areas suitable for perennial vegetation that can outcompete seabeach amaranth. Overall, it is likely that a more expansive dry beach area would result in a net benefit to seabeach amaranth.

Research on the consequences of beach nourishment to amaranth seeds is inconclusive. The U.S. Army Corps of Engineers (1995) found that amaranth at Masonboro Inlet was more abundant in areas that recently received dredged material. Dredging activities could uncover buried seeds and allow them to germinate in deposited areas. (This benefit is unlikely to occur during this project if dredged material is supplied from areas offshore that do not contain amaranth seeds.) In contrast, Hancock (1995) concluded that amaranth seedlings generally do not emerge from depths of sand greater than 1 cm and beach nourishment may be detrimental if placed on top of seeds.

Although the proposed project will ultimately enhance seabeach amaranth habitat, the disposal of sand may initially bury seeds and slow germination. Therefore, the proposed project may affect but is not likely to adversely affect seabeach amaranth.

As stated above, the BHI project would affect approximately 1.7% of the total length of shoreline of Onslow Bay and Long Bay. Given funding and logistical constraints of these projects, it is improbable that all or even most of these projects would be constructed at once. Assuming these projects follow avoidance measures, adjacent unaffected portions of beach will be available for germination of this plant while nourishment activities in other areas potentially expand its habitat for germination in later seasons. For these reasons, cumulative effects to seabeach amaranth would be neutral.

6.3 Sea Turtles

In North Carolina, the Kemp’s ridley sea turtle is known to occur in estuarine and oceanic waters, whereas the hawksbill and leatherback are found primarily in oceanic waters (Schwartz 1977, Epperly et al. 1995). These species are found in North Carolina waters all year but can be present in inshore waters April through December (Epperly et al. 1995). The hawksbill sea turtle and Kemp's ridley sea turtle are not known to nest along the Brunswick County beaches. The leatherback sea turtle primarily nests on beaches in the tropics, but is occasionally observed nesting in areas north of Florida (Rabon et al. 2003). In 2010, one leatherback sea turtle laid a nest on East Beach on Bald Head Island. Prior to that, the closest known leatherback nesting sites to the project area were in Georgetown County, SC and Carteret County, NC.

In North Carolina, the loggerhead and green sea turtles are found in North Carolina waters all year but can be present in inshore waters April through December (Epperly et al. 1995). Both species are known to frequently use coastal waters as travel corridors and have been observed migrating along the North Carolina coast (Epperly et al. 1995). Loggerhead turtles are known to regularly nest at Bald Head Island. Staff of the Bald Head Island Conservancy (BHIC) patrol the beach front daily during the nesting season to document and monitor sea turtle nests. Between 1980 and 2011, an average of 97.4 nests per year was recorded on Bald Head Island, with the majority of the nests occurring along South Beach and East Beach (BHIC sea turtle data). Between 2007 and 2011 an average of 19 nests per year were noted within the project area. In 2006, one green sea turtle nest successfully hatched from the south-facing beach of the project area (Dewire, personal communication.). In 2011, three nests successfully hatched from the south-facing beach of the project area. Since green sea turtles appear to have strong nesting site fidelity and often lay eggs on the same beach on which they hatched (USFWS 1992, Carr et al. 1978), surviving female green sea turtles will likely return to Bald Head Island for future nesting habitat.

In March 2013, the U.S. Fish and Wildlife Service proposed the designation of 739.3 miles of shoreline, 84% of all known nesting area, in the states of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi as critical habitat for the Northwest Atlantic Ocean Distinct Population Segment (DPS) of the loggerhead sea turtle. Bald Head Island is included in this proposed critical habitat protection area. Likewise, the National Marine Fisheries Service (NMFS), proposed critical habitat for this DPS of the loggerhead within the Atlantic Ocean and the Gulf of Mexico. Specific areas proposed for designation by NMFS include 36 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors.

While dredge and project-related nourishment activities would be scheduled to occur between November 16th and April 30th, groin construction would likely extend into the sea turtle nesting and migratory periods. The proposed project could potentially affect loggerhead and green sea turtles in three ways. First, dredging activities proposed to occur offshore may occur in areas used by migrating juveniles. The act of dredging material may adversely affect juvenile turtles. However, the movements of a cutter suction dredge would be limited to the spatially constrained borrow area and should therefore pose substantially less collision threat to migrating sea turtles than normal commercial ship traffic. Second, nourishing the beach with the fill material may affect nesting activities by altering nesting habitat. If the beach becomes too hard through the compaction of deposited nourishment sediments by construction equipment, it could present a physical barrier to turtle nest digging. Furthermore, placement of sand on beaches may influence physical characteristics of beaches such as sand-grain size and shape, silt-clay content, sand compaction, moisture content, porosity/water retention, gas diffusion rates, and color of sand grains which could alter the temperature of the beach. These factors could reduce reproductive success of nests laid in nourished areas (Crain et al., 1995; Ackerman, 1996). However, more stringent sediment compatibility standards and well-established mitigation measures will help to avoid or reduce any potentially adverse cumulative effects. Third, the terminal groin and continued maintenance and occurrence of the sand tube groinfield may result in indirect effects to both adult nesting females and emerging hatchlings. Hardened structures exposed above the beach or buried by accreting sand have the potential to adversely affect nesting turtles during nest site selection or during nest digging (resulting in false crawls or false digs). Groin structures may also concentrate predators (either birds or fish) and present physical impediments to hatchlings. Resultant increased energy expenditure by hatchlings can affect their ability to reach offshore developmental areas (Davis et al., 2002).

The proposed project and other beach nourishment projects of its kind are designed to offset the erosive loss of sand. The net result of a widened, more stable beachfront has been cited to facilitate turtle nesting. Beach nourishment projects have been most abundant (both in numbers and length of shoreline) in Florida, a state with a documented upward trend in turtle nesting sites. North Carolina provides vast beachfront area considered suitable for nesting of the five species of sea turtles. Overall, the actual number of sea turtle nesting sites occurring in North Carolina is relatively small compared to the entire southeastern coast (i.e. beaches of Florida, Georgia, South Carolina, and North Carolina, combined). In light of these factors, it is believed that that the cumulative effects of multiple actions would be considered neutral in the net.

6.4 Intertidal and Subtidal Soft bottom Habitat (including shoals)

Benthic infauna (e.g. polychaete worms, amphipods, and mollusks) will be subject to immediate adverse impacts associated with the removal of sand and entrainment of infaunal and non-motile epibenthic organisms. Physical removal of sediments from a borrow site removes benthic habitat, along with resident infauna and epifauna incapable of avoiding the dredge head, and can yield pronounced population effects to the benthos (USFWS 2000). Studies along the east, gulf and west coasts of the United States document similar trends of 84% to 90% decrease in the number of benthic organisms post-dredge (ASFMC 2002). Continual maintenance of Wilmington Harbor began in 1870 and harbor dimensions have been increased incrementally for over 100 years. Ongoing channel maintenance operations of the harbor routinely disturb benthic populations in the existing deep water channel and nearby side slopes. The benthic assemblages characteristic of the Cape Fear River and nearshore ocean (including the prospective sand source sites) are dominated by opportunistic species which recover quickly from environmental disturbances.

Potential physical effects of dredging typically include alteration of wave dynamics and sediment transport mechanisms; shoal deflation; and exposure of sediments with different physical characteristics (grain size, chemical composition, etc.). The rate of sediment recovery will fluctuate based on location, time of dredging, volume of sediment removed, sediment transport rate and storm characteristics following dredge events. In high energy sandy environments, the effects of sediment alteration are often minimized (Saloman et al. 1982, Pullen and Naqvi 1983). Studies have documented recovery of sediment characteristics within several months (Bowen and Marsh 1988).

While species abundances has been shown to return to pre-dredging conditions rather quickly, species composition and diversity indices may remain altered for a period of time subsequent to excavation. Posey and Alphin (2002) concluded that the rapid infilling of a borrow site (resulting from strong water currents and dynamic sand movement) contributed to a relatively quick species recovery. Based upon the results of this study, inter-annual variability contributed more to the observed differences in species abundance than the sediment removal effects (Posey and Alphin 2002). Similar benthic recovery trends were documented during biological monitoring efforts initiated by VBHI following excavation of Jay Bird Shoals in 2010. Data collected over the four year course of study indicate that the benthic community inhabiting the Jay Bird Shoals borrow site recovered quickly from any potential deleterious effects of project activities (LMG 2011, 2012, 2013). During pre-construction and post-construction monitoring, Jay Bird Shoals was dominated by amphipods, particularly *Protohaustorius wigley*, and other taxa which are adapted to life in environments prone to natural disturbance. These taxa presumably recolonized quickly after project construction and were joined by other taxa that may have capitalized on the reduced competition for space associated with recently disturbed habitats. While there were noticeable dominance patterns throughout the course of study, there was some deviation in the species present between years, likely a reflection of natural inter-annual variability typical of benthic infaunal communities. The rapid re-colonization of Jay Bird Shoals resulted in a relatively stable benthic community assemblage which persisted during subsequent monitoring events.

The recovery of the benthos at the recipient site would be reliant on immigration (active or passive) of organisms from the adjacent undisturbed areas and larval recolonization from the water column. A number of studies have indicated relatively rapid recolonization and recovery of the benthos subsequent to dredging operations provided that the post-dredge environment is favorable for colonization and peak periods of larval recruitment are avoided (Pullen and Naqvi 1983; NRC 1995; Hackney et al. 1996; Schaffner et al. 1996; Bergquist et al. 2008).

Placement of sand at the beach fill site will bury the majority of benthic infauna as existing soft bottom habitat is converted to dry beach and wet beach habitat. Nourishment impacts on the target beach would be most severe for small, relatively immobile species that are unable to burrow through the new sediment. Larger, more mobile organisms will burrow through the newly placed sediment or avoid the area of disturbance by migrating to neighboring unaffected areas. As a result of the dredge and pump processes, it is likely that disposal materials will be devoid of live benthic species. Benthic regeneration within soft bottom habitat will vary depending upon the magnitude of the disturbance, the character of the new sediment interface, rate of sediment recovery duration and timing of the dredging, the type of equipment used to extract the sediment, life history characteristics of colonizing species and water quality (Pullen and Naqvi 1983; NRC 1995). Areas that are slow to return to pre-nourishment conditions may never fully recover before subsequent nourishment events. However, relatively small, opportunistic species of polychaetes and amphipods tend to be the numerically dominant benthic macrofauna of intertidal and subtidal flats. In addition, implementation of the state sediment criteria would ensure the use of beach compatible sediment for present and future nourishment/disposal projects facilitating a favorable environment for recovery of the benthos.

Federal dredge disposal and Village-sponsored nourishment efforts on Bald Head Island would contribute to the removal of subtidal bottom and/or sandy shoals of the area, which in turn, has the potential to result in cumulative impacts to benthic communities residing within these habitats. However, the cumulative amount of sediment removed for disposal and nourishment efforts on Bald Head Island reflects a small percentage of the overall soft bottom and sandy shoal habitat identified in the region. Any impact to soft bottom habitat would be offset to a degree by the predicted increase in soft bottom resulting from erosion of upland habitats. Furthermore, the extent of the potential adverse impact relative to the amount of soft bottom habitat on a regional scale, in conjunction with the capacity of this type of habitat to accommodate additive effects, would minimize the risk of any cumulative impacts.

The USACE has identified Frying Pan Shoal as the sand source for the Brunswick County Beaches Coastal Storm Damage Reduction Project. The USACE is in the process of preparing a DEIS for the project in accordance with NEPA. Actual implementation of the project is likely to be at a much later date (if implemented at all) than the VBHI Shoreline Protection Project. As such, time crowding of actions and associated additive impacts would become less of an issue. Given the size of the shoal feature relative to any prospective borrow sites, spatial crowding effects are likewise to be minimal. As a result, cumulative impacts potentially affecting this resource are not anticipated.

Construction of the terminal groin would permanently replace part of the beach with granite armor rock. Benthic infauna incapable of horizontal movement would be permanently lost and eventually replaced with species capable of inhabiting rock substrate and interstitial spaces between the rocks. While construction of the terminal groin would contribute to the loss of benthos, the cumulative loss of benthic infauna associated with construction of hard structures is offset by the amount of undisturbed soft bottom along the coast of the Cape Fear region. As previously noted, the extent of existing soft bottom habitat in conjunction with its resilience to disturbance (either natural or anthropogenic) reduces the risk of cumulative impacts.

6.5 Water Column (including federally-managed species)

The water column provides a basic ecological role in the assimilation of energy and nutrients at the base of the food chain through primary productivity, largely by phytoplankton, and benthic-pelagic coupling. The water column also serves as habitat for pelagic species in varying life stages while providing a corridor for numerous anadromous and catadromous species.

6.5.1 Water Column Effects at Borrow Sites

It is the applicant's proposal that the sand fillet for the proposed terminal groin be augmented by the disposal of the next federal navigation channel maintenance event. Supplemental sand (as needed) would be sourced from either Jay Bird Shoals or Bald Head Creek Shoals. The proposed Jay Bird Shoals borrow area is located within the undredged portions of the borrow site that had been previously authorized for the Village-sponsored beach nourishment project constructed in the winter of 2009/2010[1]. Other sources of sand for fillet maintenance and maintenance of West Beach include the federal navigation channel and the ebb tidal shoal of Bald Head Creek. Frying Pan Shoals has been identified as a future borrow source for nourishment beyond Year 3 (particularly for anticipated nourishment needs in Year 12, 21, and 30).

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[1] The previous authorization for use of the Jay Bird Shoals borrow site was for the specific action completed in 2010 and has no bearing on permit decisions for future proposed actions.

Impacts to the water column associated with dredging are associated principally with the entrainment of infauna, epifauna, and demersal species. Mortality of organisms (i.e. plankton, pelagic eggs and larvae to pre-flexion stage individuals) within the water column that lack the ability to escape the suction field of an operating dredge and subsequent entrainment in the flow of water and sediment passing through its pumping equipment is likely. However, the effect is believed to be negligible based upon: (1) the very small volumes of water pumped by dredges relative to the total amount of water in the water in the vicinity of the operating dredge; (2) the extremely large numbers of larvae that are produced by most estuarine-dependent species; and (3) the high natural mortality rate for early life stages of many fish species (USACE 2000). The risk of entrainment has been evaluated for the Cape Fear River mouth itself. The USACE (2000) estimated that the amount of water intercepted by the largest operating hydraulic dredge (30-inch diameter pipe) is less than 8/10ths of 1% of the average daily river flow. Motile organisms, including most fish assemblages capable of escaping the suction field will likely relocate to other areas while dredging activities take place.

Localized turbidity impacts are anticipated by the removal of substrate from the borrow site as well as overspill associated with the dewatering of dredge sediment. While the identified borrow sites are characterized as high-energy, sandy environments, background turbidity levels are expected to increase during project implementation. However, these effects are expected to be localized and short-term. Turbidity levels in waters outside of the immediate vicinity of the operating dredge should be less than 25 NTUs (USACE 2000).

Pullen and Naqvi (1983) found that motile animals were the least affected by dredging and concluded that benthic and fish utilization likely depends upon water quality of the dredge area. Provided the dredge area does not form an anaerobic pit of organic-laden sediment, biological communities may be restored rather quickly. In addition, multiple studies have indicated rapid recovery of fish utilization at locations with high water and sediment dynamics such as tidal channels (Pullen and Naqvi 1983; Van Der Veer et al. 1985; Musick 1998; Schaffer et al. 1996). The prospective sand source sites considered for Village-sponsored nourishment are sandy, depositional features and thus should not be susceptible to water column impairments nor to the subsequent secondary effects on benthic and fish resources.

6.5.2 Water Column Effects at Nourishment Site

The potential effects to water column in the littoral zone during nourishment are minimized through the use of beach-compatible sediments consisting of more than 90% sand (USACE 1997). In general, the spatial scale of elevated turbidity related to beachfront disposal is very small (USACE 2001). Federal disposal actions have been demonstrated to utilize beach-compatible sand since much of the source material is derived from the adjacent beaches and shoals. Prior to use of any sand source site by the Village, minimum state sediment compatibility standards must be met. Available sediment data from each of the four prospective sites indicate the presence of beach-compatible sand in sufficient volumes for nourishment. Each of the sites consists of sediments characterized by a high percentage of sand by percent weight and low percentage of fines (see Olsen 2007, Athena Technologies 2009, Catlin 2010, and LMG 2013). Thus, effects to the water column from nourishment are expected to be spatially confined and temporal.

The indirect impact of turbidity on mortality, growth, and spawning behavior for surf zone fish is not well documented but is likely not significant since most adult fish are mobile enough to avoid areas of highest turbidity. Given the avoidance behavior of mobile species, nourishment is expected to influence fish distribution. However, many surf zone species are adapted to relatively high ambient turbidity levels and it is largely inferred in the literature that impacts to fish are more closely related to changes in and/or loss of benthic prey resources than temporary changes in water column characteristics (USACE 2001; Hackney et al. 1996). Ross and Lancaster (2002) reported that species (such as pompano and kingfish) that utilize the surf zone for nursery areas exhibit high site fidelity and are therefore more vulnerable to localized effects to benthic assemblages (Ross and Lancaster 2002). Increases in suspended sediments may also adversely affect the feeding behavior of visually-orienting fish (Wilber et al. 2003).

The construction of the terminal groin is proposed to take place concurrent with, and subsequent to, the placement of the fillet. A portion of the stem section and all of the head section will likely be constructed in open water. Placement of the armor stone would be accomplished using a barge and crane or potentially through the use of a temporary trestle structure constructed parallel to the terminal groin. The trestle would be supported by steel pilings jetted into the substrate and removed once construction is complete. However, phasing of the project would reduce the need for the use of a trestle. Depending upon conditions at the time of the groin installation, it is likely that equipment will be able to be operated from sand pads formed from the fillet. Any effects to the water column as a result of increased turbidity from construction would be expected to be localized and short-lived.

Due to their mobility and range, surf zone fishes utilizing the project area to forage upon benthic macrofauna (e.g. mole crabs and coquina clams) would move to adjacent undisturbed beach areas and other suitable feeding zones for the temporary period of construction. Surf zone conditions would resume a pre-construction mode relatively quickly.

It has been reported that shore-perpendicular structures such as groins or jetties have the potential to impede longshore transport of larvae and natural passage into estuaries or sounds and thus negatively impact recruitment success (Blanton et al. 1999; Hare et al. 1999). In particular, the presence of jetties has the potential to deflect larvae to an extent that would eliminate the opportunity for the larvae to be entrained into the estuary (particularly for relatively small coastal inlets). For the Oregon Inlet project, it was asserted that construction of duel jetties would result in the reduction of ocean-spawned larvae from reaching estuarine nursery areas (USACE 1999).

While a dual jetty system of an inlet presents a vastly different set of physical and biological conditions than that of the proposed terminal groin on Bald Head Island near the mouth of the Cape Fear River, hypothetical particle ingress into the Cape Fear River estuary was nonetheless simulated via Delft 3D modeling by Olsen Associates. The drogue simulations were intended to represent larval fish pathways into the estuary under two scenarios: (1) ingress with beach fill; and (2) ingress with beach fill and a terminal groin in place. The presence of the terminal groin appears to have no significant limiting influence on the ability of particles (hypothetical larval fish) to enter the estuary. The complete model report of findings is provided in Appendix J of the DEIS. The size of the structure relative to the hydraulic field of the Cape Fear River mouth is negligible. As a result, larval entrainment into the Cape Fear River estuary will remain unaffected. In addition, the post-construction template would result in a shoreline configuration that effectively extends the shoreline to the waterward extent of the structure. Given these considerations, it is believed that the post-construction condition would be conducive for unimpeded passage of fish and larvae into the Cape Fear River estuary.

The terminal structure will likely provide foraging and shelter opportunities for surf zone fishes thus adding to species abundance and richness to the soft bottom community (Peters and Nelson 1987; Clark et al. 1996). Cenci et al.'s (2010) study focused on installation of shoreline stabilization structures in areas characterized by soft bottom habitats. The data collected on fish populations indicates that during the early stages following new groin construction, species diversity and richness increased dramatically. These new structures become fish "producers" by providing habitat for local and transient fish assemblages. However, introduction of artificial structures may also be viewed as a habitat trade-off in which species assemblages may be altered. In addition, hardened structures have been cited as being susceptible to invasion by non-native species (Bulleri and Chapman 2010).

The hydrodynamics of the lower Cape Fear Estuary create a dynamic environment. The water column is subject to wind and current-induced mixing and daily tidal exchange with the Atlantic Ocean. Additionally, the presence of the terminal groin appears to have no significant limiting influence on the ability of particles (hypothetical larval fish) to enter the estuary. In consideration of other past, present, and reasonably foreseeable future actions in the coastal Cape Fear region, no cumulative impacts to the water column are anticipated.

6.6 Water Quality

Marine and estuarine waters may experience elevated, localized turbidity as a result of the placement of disposal materials on the beach as well as dredging activities in the channel. As part of the federal navigation project, beach-compatible dredged material (sands) dredged from the ocean bar or river channel is regularly placed on the recipient beach. Turbidity effects from fill placement are directly related to grain size. The high percentage of sand in the dredged material will allow for more rapid settling of sediment following placement activities. In addition, the tidal currents and hydrodynamics of the Cape Fear River estuary provide a means for water mixing and dilution. Turbidity created by the disposal operation normally does not persist beyond more than one or two tidal cycles (12 to 24 hours) following the cessation of the disposal operation (USACE 2000).

Dredging and associated suspended sediment plumes can have short-term and localized effects on water quality. These include chemical transformations resulting from the oxidation of sulfides and of ferrous iron (Fe^{2+}) which in turn can lead to reductions in dissolved oxygen (DO). Oxidation of sulfides can also lead to localized reduction in pH levels in the water column (Jabusch et al. 2008). DO levels over the dredge site can also be suppressed via the release of oxygen-demanding material (e.g. organics). However, bottom sediments of the proposed borrow sites exhibit a high percentage of sand by weight with low percent organic matter. In addition, the waters at the mouth of the Cape Fear River tend to be well-oxygenated (Mallin et al. 2012) and thus less susceptible to impairment from any localized increases in DO.

Disturbance activities associated with federal maintenance of the channel (i.e. dredging and dredge disposal) would occur within the open waters of the Cape Fear River estuary where hydrodynamics of the water column are subject to semi-diurnal tidal exchange as well as wind and current induced mixing. Elevated turbidity levels would be localized and temporary due to mixing and dilution. The incremental contribution to cumulative water quality impacts from the proposed action in combination with other regional navigation projects and water dependent development activities would be negligible.

6.7. <u>Human Communities</u>

The net beneficial effect of soft stabilization measures (i.e. beach nourishment) and engineered structures is the protection of properties and infrastructure as well as the use of a more expansive and stable beachfront. Since Bald Head Island is a planned unit development, efforts to widen and stabilize the beachfront protect existing platted lots, constructed residences, and existing infrastructure. Beach restoration will not allow for additional development or the recordation of new lots on the Island. The cumulative benefit to the human community is protection of existing structures/infrastructure and enhanced recreational use. These benefits are realized by permanent residents, part-time residents, vacationers, and visitors to the Island.

Stabilization measures along the coast of North Carolina help to protect a significant property tax base to local municipalities. In addition, protection of existing structures, infrastructure, and recreational beach ensures a viable and critical tourist industry for the State. Thus, multiple projects occurring in a single location (e.g. Bald Head Island) or in multiple locations (e.g. beachfront communities of North Carolina) are considered cumulatively beneficial to the human community resource.

7.0 ACTIONS TO REDUCE CUMULATIVE IMPACTS

Cumulative effects are not anticipated from the Village of Bald Head Island Shoreline Protection Project. Over the course of the last few years, the applicant has evaluated numerous alternatives and implemented various measures in an effort to mitigate environmental impacts potentially resulting from nourishment activities. Section 6.0 of the DEIS describes the mitigative measures to be employed by the Village of Bald Head Island. Detailed monitoring and mitigation efforts associated with construction of the terminal groin are also included within the Inlet Management Plan (Appendix B of the DEIS). Collectively, monitoring and mitigative measures will reduce the potential for cumulative impacts related to proposed dredging, nourishment, and terminal groin construction.

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